NOV 18 1943

The Engineer

Vol. CLXXVI—No. 4580 | 28, ESSEX ST., STRAND, LONDON, W.C.2 | OCTOBER 22, 1943

Established 1856 | Price One Shilling, by Inland Post 1s. 3d. | Registered as a Newspaper

REMOTE CONTROL
ANY FORCE & ANY DISTANCE

Lockheed
HYDRAULIC
AUTOMOTIVE PRODUCTS COMPANY LTD., ENGLAND

As busy as a Bee...

Coles Cranes are too useful to be anything but busy. Everything that a crane can do (and many jobs we used to think they could not) they are doing now, all over the country, to help speed the war effort. They travel under their own power, make their way into the smallest spaces, and handle the most inaccessible loads by their 360° slewing action. Long life... exceptional lifting power... extreme stability... load remains stationary whilst jib is raised and lowered ... these are but a few of their outstanding features.

COLES CRANES SERVE THE WORLD'S WAR FRONTS TODAY – THE WORLD'S INDUSTRIES TOMORROW

For Mobile Lifting Power

COLES CRANES

STEELS ENGINEERING PRODUCTS LTD.
MECHANICAL HANDLING DIVISION, CROWN WORKS, SUNDERLAND

C.9

The Engineer

LONDON, FRIDAY, OCTOBER 22, 1943.

PUBLIC NOTICES

UNIVERSITY COLLEGE OF SWANSEA

The Council Invites Applications for the POST of PROFESSOR OF ENGINEERING. Minimum salary £1000 per annum. It is hoped that suitably qualified persons engaged in national service will apply. Further particulars may be obtained from the undersigned, by whom applications must be received on or before November 20th, 1943.

EDWIN DREW,
Registrar.

Singleton Park, Swansea. 8331

JAMAICA GOVERNMENT RAILWAY

ASSISTANT ENGINEERS

Applications are Invited for the following POSTS with the Jamaica Government Railway for one tour of three years in the first instance, with possibility of permanency. Free passages provided.

FIRST ASSISTANT ENGINEER. Salary £700 by £50 by £750 a year. Candidates should preferably be A.M.I.C.E. or hold an equivalent qualification, and have had practical experience in Railway Engineering, Railway Construction Work and Survey in the field and in the office of a Railway Chief Engineer. Ref. E.776.

SECOND ASSISTANT ENGINEER. Salary £525 by £25 by £550 a year. Higher initial salary according to qualifications and experience. Candidates must have passed Sections A and B of the A.M.I.C.E. Examination or hold a University Degree in Civil Engineering, and have had regular training as a Civil Engineer on Railway Works, with experience of Construction Maintenance and in the field on Bridge Construction. They should have a thorough knowledge of the Design and Construction of Bridges, and should be quick and accurate Surveyors. They should also be capable of Taking Charge of a Drawing-office if required to do so. Ref. E.777.

Write, stating age and full particulars of qualifications and experience, and quoting reference number of post applied for, to THE MINISTRY OF LABOUR AND NATIONAL SERVICE, CENTRAL (TECHNICAL AND SCIENTIFIC) REGISTER, ALEXANDRA HOUSE, KINGSWAY, LONDON, W.C.2. 8458

SIERRA LEONE

FORESTRY DEPARTMENT

Overseas Employment.—PERSONNEL REQUIRED for the Sierra Leone Forestry Department for one tour of 18 to 24 months in the first instance. Salary according to qualifications and experience, as shown below. Free passages and quarters.

CONSERVATOR. Candidates must be Qualified Mechanical Engineers, with experience in Sawmilling, Steam Engines, and Mechanical Engineering Operations. Salary, £720-£30-£840 a year.

ASSISTANT FOREST ENGINEER. Qualifications as for Forest Engineer. Salary, £600-£30-£840 a year.

SAWMILL MANAGER. Candidates must have a sound knowledge of all Sawmilling Operations, including Saw Doctoring and Mill Repairs. Salary, £560-£12-£600 a year. Separation allowance on £560 is £21. Outfit allowance £25.

SAWMILL FOREMAN. Candidates must have a sound knowledge of Sawing, be able to sharpen Saws and should, if possible, have some experience of Saw Doctoring. Salary, £400-£12-£500 a year. Separation allowance on £400 is £128. Outfit allowance £25.

FITTER DRIVER. Candidates must have a sound knowledge of Motor Vehicles and Caterpillar Tractors, and be able to Operate Tractors when conditions are too difficult for part-trained African operators. Salary, £400-£12-£500 a year. Separation allowance on £400 is £128. Outfit allowance £25.

Written applications (no interviews), giving full particulars of age, National and Armed Forces Registration Numbers, training, experience, and name of present employers, should be sent to THE SECRETARY, OVERSEAS MANPOWER COMMITTEE (Ref. 1114), MINISTRY OF LABOUR AND NATIONAL SERVICE, ALEXANDRA HOUSE, KINGSWAY, LONDON, W.C.2. 8467

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

COMMERCIAL MANAGER REQUIRED for old-established company of international repute, Midland area. Engineering works. Only applicants of proved ability in Organisation and outstanding initiative and personality will be considered.—Address, stating age, experience, qualifications, salary, and references, 8451, The Engineer Office. 8451 A

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE
ARRANGED FOR CARD INDEXING
(TABLE OF CONTENTS, PAGE 326)

Salvage at Pearl Harbour—No. I (P. 318)
THE ENGINEER, 22 - 10 - 43

Engineers and the British Empire No. XVI (P. 320)
(C. A. M. SMITH) THE ENGINEER, 22 - 10 - 43

John Henry Hamilton and the Positive Scavenging Engine—No. III (P. 320)
(A. K. BRUCE) THE ENGINEER, 22 - 10 - 43

Regional Water Supplies and Main Drainage (P. 322)
THE ENGINEER, 22 - 10 - 43

Iron and Steel Institute (P. 324)
THE ENGINEER. 22 - 10 - 43

Jet-Propelled Aircraft (P. 326)
THE ENGINEER, 22 - 10 - 43

Unfounded Assertions (P. 326)
THE ENGINEER, 22 - 10 - 43

BABCOCK VALVE VALUE

INDEX TO ADVERTISEMENTS, PAGE 55

THE FACT that goods made of raw materials in short supply owing to war conditions are advertised in this paper should not be taken as an indication that they are necessarily available for export.

SITUATIONS OPEN

TO ADVERTISERS UNDER BOX NUMBERS IN SITUATIONS OPEN SECTION.

For the benefit of applicants, the Proprietors are prepared to insert brief notices that vacancies are filled, upon receipt of notifications from the Advertisers. These notices (limited to one line) will be free of charge, and co-operation is asked for.

IMPORTANT

Advertisers in Situations Open Column should make themselves acquainted with the terms of

STATUTORY RULES & ORDERS 1941 No. 2069

RESTRICTION ON ENGAGEMENT ORDER

PERSONNEL MANAGER REQUIRED by Engineering Company employing approx. 3000 on essential work; permanent position with good prospects; applicants should have first-class experience in modern methods of Personnel Management, and must have held a position in charge of a Personnel Department for at least three years. Engineering experience an advantage. Applications should state age and salary required, and give full details of experience.—Address, 8466, The Engineer Office. 8466 A

SITUATIONS OPEN

ADVERTISERS, Engaged in the Manufacture and Processing of Chemicals, REQUIRE a GENERAL WORKS MANAGER to Supervise and Control the Operation and Production of Two Factories situated in the Midlands. The position offered is permanent and the post-war prospects are considered to be excellent. Applicants between the ages of 35 and 45 should be fully experienced, accustomed to responsibility, and good disciplinarians. First-class references are essential, and the salary will be commensurate to the position.—Applications, which should give fullest particulars, to be addressed 8394, The Engineer Office. 8394 A

EDITORIAL ASSISTANT (Male) REQUIRED by the Institution of Electrical Engineers. Candidates must have good education, a Physics or Engineering Degree, and preferably membership of an Engineering Institution. Editorial experience would be an advantage. Salary of the order of £450 to £500 per annum.—Applications, in writing only, should reach the SECRETARY of the INSTITUTION, Savoy Place, W.C.2, not later than 25th October, marked "Editorial." 8468 A

SALES ENGINEER ASSISTANT WANTED, controlled (E.W.O.) firm; must be good Technical Correspondent, with Engineer Training in Structural and Fabricated Products.—Write, giving full details, COMMERCIAL STRUCTURES, Ltd., Staffs Works, Leyton, E.10. 8446 A

PUBLIC NOTICES

BOROUGH OF DOVER

APPOINTMENT OF BOROUGH ENGINEER AND SURVEYOR AND WATER ENGINEER

The Town Council Invites APPLICATIONS for the above APPOINTMENT from duly qualified Civil and Water Engineers, with Local Government experience, at a salary of £800 per annum, rising by annual increments of £50 to a maximum of £1000 per annum, plus cost-of-living bonus, at present £28 3s. 4d. per annum, with free house and garden, including rates, taxes, firing, and lighting.

Two private pupils will be allowed, but no private practice.

Applicants must be Corporate Members of the Institution of Civil Engineers or hold the Testamur of the Institution of Municipal and County Engineers.

The appointment is subject to the provisions of the Local Government Superannuation Act, 1937, and the successful applicant will be required to pass a medical examination.

Particulars of duties and form of application may be obtained from the undersigned on receipt of a stamped addressed envelope, to whom applications, accompanied by copies of three recent testimonials, must be returned, marked "Borough Surveyor," not later than Monday, 15th November next.

Canvassing, directly or indirectly, will disqualify.

S. R. H. LOXTON,
Town Clerk.

Town Clerk's Office,
Brook House,
Dover.
16th October, 1943. 8470

SITUATIONS OPEN

MANAGER for Methods and Time Study Department REQUIRED by large established Engineering Works. Salary about £1000. Applicants must be men of applied practical training and experience in these duties. Used to responsibility and sound organiser.—Address, stating experience, qualifications, references, and salary, 8452, The Engineer Office. 8452 A

PRODUCTION MANAGER.—APPLICATIONS are INVITED for the POSITION of PRODUCTION MANAGER at a large Aero-engine Factory. The appointment carries full control of the production side of the factory. A specialist knowledge of Modern Machine Tool Plant and Equipment engaged on producing Aero-engine Components of a high grade and over a wide range is required. Previous experience in the capacity of Production Manager in a similar organisation is essential. Excellent opportunity for the right man. Salary will be commensurate with qualifications.—Address, 8416, The Engineer Office. 8416 A

STRUCTURAL STEELWORK.—MANAGER to Take Charge of well-established department of N. of England Works fabricating pre-war and present about 25,000 tons per annum. All types, including electric welding. Control of existing efficient staff and organisation on Design, Sales, Production, and Erection sides.

Previous executive control in similar position desirable, age preferably not over 45. Salary and war bonus to suitable man, according to qualifications and experience, which should be fully stated.

Address, 8471, The Engineer Office. 8471 A

SITUATIONS OPEN (continued) Page 2
SITUATIONS WANTED, Page 2
AUCTIONEERS & VALUERS, Page 56
BUSINESSES and PREMISES For Sale, &c., Page 56
AGENCIES, Page 2
FOR SALE, Pages 4 and 56
EDUCATIONAL, Page 2
PATENTS, Page 2
MISCELLANEOUS, Page 2
MACHINERY, &c., WANTED, Page 2
SUB-CONTRACTING, Page 2

For Advertisement Rates see First Column Overleaf

CLASSIFIED ADVERTISEMENTS CLOSE FOR
PRESS-NOON WEDNESDAYS

The Engineer

Annual Subscription Rates

(including postal charges)

BRITISH ISLES	£3	5	0
CANADA...	£2	18	6
ABROAD...	£3	3	0

(except Canada)

ADVERTISEMENTS

The Charges for Classified Advertisements are 1/6 per line up to one inch—minimum charge, 6/-; those occupying one inch or more at the rate of 18/- per inch. Box numbers, 1/- extra, except in the case of advertisements under "Situations Wanted." Orders MUST be accompanied by a remittance. The rates for Displayed Advertisements will be forwarded on application. Classified Advertisements cannot be inserted unless delivered before TWO o'clock on Wednesday afternoon.

Letters relating to the Advertisement and the Publishing Departments of the Paper are to be addressed to the Publisher; all other letters are to be addressed to the Editor of THE ENGINEER.

Postal Address,
28, Essex Street, Strand, London, W.C.2.

Teleg. Address,
"Engineer Newspaper, Estrand, London."
Tel., Central 6565 (10 lines).

SITUATIONS OPEN

SHEET METAL WORK, N.W. LONDON.—TECHNICAL MAN REQUIRED IMMEDIATELY to Supervise Production and Develop Jobs from Drawings.—Address, P6390, The Engineer Office. P6390 A

THE MINISTRY OF LABOUR AND NATIONAL SERVICE INVITE APPLICATIONS for the POSITION of qualified METALLURGIST, to be responsible for the Technical Control of a Heat Treatment Shop in the North Midlands.

Applicants should be in possession of the Final Metallurgical Certificate of the City and Guilds Institute or similar qualifications, and have had practical experience of Heat Treating Modern Alloy Steel and be conversant with the Emergency Wartime Specifications. Experience in Tool Hardening, including the use of substitute High-speed Steels, is necessary. Knowledge of the Firing of Town Gas-Fired Furnaces would be an advantage. The successful applicant would be required to undertake a certain amount of night work. Salary to be arranged.—Applicants should write for the necessary application form to the MINISTRY OF LABOUR AND NATIONAL SERVICE, Central (Technical and Scientific) Register, Alexandra House, Kingsway, London, W.C.2, quoting reference number F.1725X. 8459 A

THE Post You Are Seeking May Not Be Advertised in this Column, but do not lose the Opportunity of Bringing your Requirements before all those who would be interested and could employ you. An Advertisement in the "Situations Wanted" Column would be seen by all Leading Engineering Concerns for the cost of Four Lines, 6s.; 1s. 6d. for each Additional Line. There is no better way of covering so large a field for such a small charge.

SITUATIONS WANTED

ADAPTABLE ENGINEER (41), NOW FREE. Experience covers estimating, tendering, contracts, D.O., works and production control, costing, labour, materials, &c.; ideal aide to management of small/medium business. Machining, welding, sheet metal, &c. Basic salary £500.—Address, P6392, The Engineer Office. P6392 B

ADVERTISER, with Wide Personal Connection with foundries, WISHES to CONTACT MANUFACTURERS interested in Equipment or Supplies.—Address, P6384, The Engineer Office. P6384 B

CHARTERED STRUCTURAL and CIVIL ENGINEER, wide experience large projects, design (steel and R.C.), structures, founds., retaining walls, quants., specifications, site supervision, surveys, accounts, SEEKS FREE-LANCE or PART-TIME WORK. Good organiser. Age 49.—Address, P6388, The Engineer Office. P6388 B

CIVIL ENGINEERING SUB-AGENT, First-class organiser and leader, with wide experience in structural steelwork and reinforced concrete, tunnels, aqueducts, jetties, bridges, and roads, &c., DESIRES SIMILAR POSITION.—Address, P6393, The Engineer Office. P6393 B

COST ACCOUNTANT, 25 Years' Practical experience works accounts, DESIRES PERMANENT PROGRESSIVE POSITION.—Address, P6389, The Engineer Office. P6389 B

ENGINEER, M. Inst. B.E., A.M.I. Mech. E., CAN BE AVAILABLE for MANAGERIAL POST requiring wide experience; part Continental, managerial, technical, practical, heavy medium, light production; good organiser, cost reducer, expert tool designer, modern methods, mass production; highest testimonials.—Address, 8463, The Engineer Office. 8463 B

ENGINEER DRAUGHTSMAN DESIRES CHANGE; capable of handling schemes from estimate to complete erection and starting up; fifteen years' experience in mechanical handling and preparing plant for foundries.—Address, P6380, The Engineer Office. P6380 B

SITUATIONS WANTED

ENGINEER, B.Sc., A.M. Inst. C.E., with civil and mechanical, construction and production experience, DESIRES POST as Production Manager or equivalent. Minimum initial salary £1000. Age 41. Only interested in progressive job.—Address, P6397, The Engineer Office. P6397 B

ENGINEER EXECUTIVE (47), FREE for APPOINTMENT; well educated, wide experience, practical and technical, proved organising ability, works and production management, modern methods and developments, planning, machine loading, time study, tool design, and manufacture, costings and accountancy.—Address, P6398, The Engineer Office. P6398 B

ENGINEER METALLURGIST, with Wide experience iron, steel, non-ferrous alloys, light alloys, and powder metallurgy, will SHORTLY BE FREE to ACCEPT EXECUTIVE POSITION. Production or research and development. Present earnings £1000, but salary of secondary importance.—Address, P6381, The Engineer Office. P6381 B

ENGINEER, Specialised in Gas and Steam heated boilers, canteen plant, installations, fuel economy, and general maintenance, SEEKS POSITION OF TRUST IMMEDIATELY; exempt.—Address, P6382, The Engineer Office. P6382 B

ENGINEER, 30 Years' Executive Position leading firm, wide experience, export, SEEKS LONDON AGENCY Steam, Electrical Specialities.—Address, P6395, The Engineer Office. P6395 B

EXECUTIVE, Young, Capable, M.P.O.A., SEEKS POST in charge purchases, subcontracts, material control; available promptly, only essential work considered.—Write, M.P.O.A., 5, Sutherland House, Sutherland Road, Ealing, W.13, or phone PERivale 5097. P6394 B

FOUNDRY MANAGER, Desirous of Change, WISHES to INTERVIEW COMPANY who require a fully trained man, technical and practical, to organise shops for post-war conditions; 25 years' experience in steel, iron, and non-ferrous castings.—Address, P6391, The Engineer Office. P6391 B

HEATING, VENTILATING, and MECHANICAL ENGINEER (24), expert draughtsman, DESIRES CHANGE, London area or overseas; release obtainable.—Address, 8464, The Engineer Office. 8464 B

If the Man You Are Seeking is Not Amongst those Advertising in this Column, a Small Announcement in the "Situations Open" Column will Quickly and Economically Produce the Right Selection of Applicants, at the same time Eliminating Waste of Effort, Waste of Time, and Waste of Opportunity. The charge is Four Lines or under, 6s.; each Additional Line, 1s. 6d. Box Numbers, 1s. extra, which includes despatch of all replies.

KEEN, Energetic ENGINEER, Long Managerial experience, sound commercial ability, accustomed full responsibility, marine and land installations, chemical, engineering, non-ferrous foundries, ordnance, NOW FREE.—Address, P6396, The Engineer Office. P6396 B

MECHANICAL ENGINEER, A.M.I. Mech. E., SHORTLY AVAILABLE; commercial, practical, technical, experience, British and U.S.A. firms.—Address, P6386, The Engineer Office. P6386 B

POSITION REQUIRED as PRODUCTION MANAGER or PRODUCTION ENGINEER; over 20 years' experience, technical and practical; sound knowledge modern production methods and organisation; min. salary, £800.—Address, P6387, The Engineer Office. P6387 B

PRODUCTION ENGINEER (32 Years), B.Sc., specialises in production planning and control, sound background of drawing-office and workshop experience, AVAILABLE in NEAR FUTURE, REQUIRES POST in EXECUTIVE CAPACITY. Present salary £800.—Address, P6383, The Engineer Office. P6383 B

AGENCIES

AGENTS REQUIRED, with Good Connections with Steam Users, for the Sale of our Products for the Treatment of Boiler Feed Water.—Address, P6376, The Engineer Office. P6376 D

PATENTS

PATENTS 501,750, for "Improvements in Tyre Valves," and 501,790, for "Improvements in or relating to Apparatus for Manufacturing Rubber Stems of Tyre and like Valves."—Owners wish to meet all demands for the patented articles and INVITE INQUIRIES from manufacturers and others competent to assist in COMMERCIALLY EXPLOITING these INVENTIONS.—Address in first instance, Messrs. DICKER, POLLAK, MERCER, TENCH and MEYER, Chartered Patent Agents, 20-23, Holborn, London, E.C.1. 8454 H

THE PROPRIETORS of BRITISH PATENT No. 509,045, relating to "Improvements in Calculating Apparatus," are DESIROUS of ENTERING into NEGOTIATIONS with one or more firms in Great Britain for the purpose of EXPLOITING the INVENTION either by SALE of the PATENT RIGHTS or by the GRANT of LICENCES on reasonable terms.—Interested parties who desire further particulars should apply to ALBERT L. MOND and THIEMANN, of 14 to 18, Holborn, London, E.C.1. 8455 H

PATENTS

THE PROPRIETOR of the PATENT No. 384,935, for "Improvements in Ladders," is DESIROUS of ENTERING into ARRANGEMENTS by way of LICENCE and otherwise on reasonable terms for the purpose of EXPLOITING the same and ensuring its full development and practical working in this country.—All communications should be addressed in the first instance to Haseltine, Lake and Co., 28, Southampton Buildings, Chancery Lane, London, W.C.2. 8453 H

THE PROPRIETORS of BRITISH PATENT No. 491,334, dated May 4th, 1937, relating to "Improvements in Winches," and BRITISH PATENT No. 530,640, dated October 15th, 1938, relating to "Improvements in Mechanism for Paying-out Hoisting Lines," are DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above PATENTS and ensuring their practical working in Great Britain.—Inquiries to SINGER, EHLERT, STERN and CARLBERG, Chrysler Building, New York City 17, N.Y., U.S.A. 8439 H

MACHINERY, &c., WANTED

WANTED, ROPE FLY-WHEEL, 14/16ft. dia., for 12/14 ropes, 1¼in. or 1½in. Full particulars.—Address, 8456, The Engineer Office. 8456 F

WANTED, ONE Motor-driven ROUTER, for 400 volts, three-phase, 50 cycles. Full particulars.—Address, 8457, The Engineer Office. 8457 F

WANTED, PUNCHING and SHEARING MACHINE, double punch, to punch up to 1in. thick. Particulars. Licence No. 151.—Address, 8469, The Engineer Office. 8469 F

ALFRED HERBERT, Ltd., Coventry, PAY BEST PRICES FOR SECOND-HAND MACHINE TOOLS in good condition by first-class makers.
Write, wire, or 'phone, and our representative will call. Authorised Dealer's Certificate No. 71. 'Phone: 88781 (20 lines), Coventry; Telegrams: "Lathe, Telex, Coventry." 1002 F

We are licensed by the Machine Tool Control for the purchase of all classes of Machine Tools, and we offer good prices for surplus Machinery in any quantities, large or small.
(Machine Tool Control Licence No. 172.)

F. J. EDWARDS, LTD.
359, EUSTON ROAD, LONDON, N.W.1
Telephone No. - EUSton 4481 (10 lines).
Telegrams: "Bescotools, Norwest, London."

INQUIRIES for FABRICATED COPPER TUBE WORK, namely:—
CALORIFIER COILS, WATER and OIL PIPES for DIESEL ENGINES, MACHINE TOOLS, and similar.

H. S. HOLDSWORTH, LIMITED,
King Street, Halifax.
8958 F

SUB-CONTRACTING

WANTED

CAPACITY AVAILABLE
for Early Deliveries.
1in. CAPSTAN, 64in. CENTRE LATHES and ENGRAVING.
FILLETTS, 155, Romford Road, London, E.15.
Part 2 A.I.D.
(MARyland 3110 and 2701.) 8151 MW

PRINTS
BLACK AND WHITE
(Ozalid Process)

SEND YOUR
TRACINGS
TO
LONDON PHOTOCRAFT LTD.,
46 and 47, CHANCERY LANE, W.C.2,
or telephone HOLborn 5825, for messenger to call.

FIRST-CLASS WORK.
REASONABLE CHARGES.
EFFICIENT SERVICE.
P6228 MW

MACHINING WORK.
For CENTRE LATHES, up to 8½in. centres and medium-sized MILLING. Good-grade work preferred.
THE LONDON ELECTRIC FIRM, Croydon (UPLands 4871). 8217 MW

MACHINING WORK REQUIRED, Large or Small Lots, suitable for Centre Lathes (9in. crs. by 8ft.), Slotters, Drills, Shapers, Planers, &c.—STRINGERS, Ltd., Wincobank, Sheffield. 8084 MW

SPECIAL MACHINES and PROCESSES for war work and post-war development DESIGNED by expert staff. Able to assist in erection and planning.—Address, 8422, The Engineer Office. 8422 MW

MISCELLANEOUS

AT LAST, a 100 Per Cent. Efficient LUBRI... for all hand-operated tools. ... results, saves tools, gives perfect work.—... for samples of "Trefolex" Cutting ... to PEARL VARNISH CO., Ltd., ... Trading Estate, near Pontypridd, Glamorgan... shire. 9097

CLEANING CLOTHS

CLEANING CLOTHS, suitable for ... purposes, are available for Munition ... Engineering Works and other Factories ... essential work.

Send order on official forms or ... heading and forward with remittance ... 8½d. each.

In lots of 10 dozen or more, 8s. 3d. ... dozen.

In lots of 50 dozen or more, 8s. per dozen.

JOHN HAWKINS and SONS, Ltd., ...
E. Dept., Greenbank Mills, Preston, Lancs. 8324 I

INDUSTRIAL GLOVES

All types suitable for Welders, Riv... and all Industrial purposes.

Actual manufacturers.

HORACE SLEEP (Industrial), ...
4, Uxbridge Street, London, W.8 ... P8356

POST-WAR DEVELOPMENT. ... GROUP of CONTINENTAL IND... TRIALISTS would like to CONTACT BRIT... MANUFACTURERS with a view ... COLLABORATION after the war.—Re... invited by established engineering firms ... and to be addressed 8385, The Engineer Of... marked Ref. FJH. 8385

TYPEWRITERS.
If you are unable to obtain a Board of Tr... permit to purchase a new typewriter, why ... have your old machine rebuilt, equal to ... seven days' service. We will loan you a mach... while rebuilding yours. We can undertak... number of contracts for monthly service, ... We hold a licence to purchase your surp... machines; 200 machines in stock, all carr... lengths.—FLEET TYPEWRITER CO., Ltd., ... 117, Fleet Street, London, E.C.4 (Tel., C... 7162, 4986). 8228 I

WELL-ESTABLISHED FERROUS and NO... FERROUS FOUNDRY WISHES to CO... LABORATE with MANUFACTURERS devel... ing post-war products involving Castings.... HOPE FOUNDRY (STOKE), Ltd., Dra... Square, Chesterton, Stoke-on-Trent. 8447 I

EDUCATIONAL

ICS CREATIVE PIONEERS O... TEACHING BY POST
offer unequalled instruction in
all branches of Engineer...

Among our many Special and Free Booklets ... "Mechanical Engineering," "Engineering Sh... Practice," "Motive Power Engineering," ... Refrigeration," "Fire Engineering," "Aer... nautical Engineering," "Electrical Engine... ing," "Motor Engineering," "Marine Engi... neering," "Civil Engineering," "Mining Engi... neering," and "Sanitary Engineering."

Write for any one (or more) of them, or ... the willing services of our Advisory Dept.

We have special terms for men in H.M. Forces.

INTERNATIONAL CORRESPONDENCE SCHOOLS, Ltd.,
199, International Bldgs., Kingsway, Lond... 9144

35 FIRST PLACES
and HUNDREDS of PASSES
in the A.M.I.C.E., A.M.I.M.E., A.M.I.E.E., A.F.R.Ae.S., A.M.I.Chem.E., C. & G., etc., Exams.
have been gained by students studying at home with The T.I.G.B. Engineering First Places are your best guide to the most successful Engineering Courses. Write to-day for "The Engineer's Guide to Success," containing the world's widest choice of Engineering Courses—over 200 —covering all branches—Mechanical, Electrical, Aeronautical, Wireless, Civil, Chemical, &c., and which alone gives the Regulations governing admission to the Recognised Institutions. The T.I.G.B. guarantees training until successful.
The TECHNOLOGICAL INSTITUTE OF GT. BRITAIN
76, Temple Bar House, E.C.4.

For continuation of Small Advertisements see page 4

A Seven-Day Journal

Radio and International Relations

At a meeting of the Institution of Professional Civil Servants, held at the Institution of Mechanical Engineers last Tuesday, October 19th, Sir Stafford Cripps read an address to a distinguished international gathering on "Radio and International Relations." He pointed out that international developments towards regulation had been forced upon the world by its necessity, if use was to be made of progress in communications. International political control would have to be further developed in such a way that it would not restrict utilisation. One of the difficulties was that freedom of use of broadcasting was liable to be abused for national advantage. Treating his subject broadly, Sir Stafford then spoke of the need to control the powers the scientists gave us in such a way that the application of new knowledge did not endanger peace. The scientist was not to be blamed that his discoveries were used for war purposes. His job ended when he had presented his discovery to the world. But the scientist was also a citizen, and he and other citizens must see to it that the politician arranged for organisation and control so that the discoveries were not abused. The war had had the effect of speeding up international scientific co-operation and removing restrictions upon it. Even before the war wireless had solved that problem in marine navigation accurately of determining longitude by the sending out of time signals. During the war, as a result of international scientific work, immense strides had been made. As an example, he said that after the war so greatly improved were methods of control, that even in landing and taking off the aviator seemed likely to be independent of visibility. But to achieve that result, and others that the scientist made possible, wise and courageous international agreement and control would be necessary. Concluding, Sir Stafford showed that he was not of those who believe all further scientific development should be arrested. It was imperative, he said, that scientists should be able to work for the benefit of mankind without frustration.

Scientific Research in Post-War Britain

A report on Scientific Research and the Universities in Post-War Britain, which has been drawn up by a Sub-Committee of the Parliamentary and Scientific Committee, was unanimously adopted by the Committee itself at a meeting held at the House of Commons on Tuesday, October 12th. The report, which was summarised in The Engineer of October 8th, has been formally submitted to the Lord President of the Council, the Chancellor of the Exchequer, the Secretary of State for Scotland, the President of the Board of Education, and to the Paymaster-General (Lord Cherwell). The hope is expressed that the Ministers most closely concerned will agree to receive a deputation to discuss the proposals in due course, when there has been opportunity to consider their implications. The report has been presented in the hope that it may be considered in connection with the Government plans for demobilisation, post-war planning, and educational reform. It may be recalled that the Parliamentary and Scientific Committee is an informal group of 116 Members of both Houses of Parliament and of representatives of thirty-eight various scientific and technical institutions.

Safety in Mines

The twenty-first annual report of the Safety in Mines Research Board, of which Sir Malcolm Delevingne is Chairman, was issued on Monday, October 18th. The report records the progress made during the year 1942 in a number of safety researches undertaken by the Board, and points out that the conditions created by the war have necessarily much impeded the execution of the Board's peacetime programme of research. New problems have been created by the war which demanded immediate attention. One of the most important of these has been the situation caused by the closing of the chief peacetime sources of supply of pit timber. This has called for much research into the use of substitutes, methods of conservation, and similar questions, and has lent additional urgency to the study of the vital problem of roof control. The Board has also been applied to from time to time by Service and Supply Departments for help in the solution of war problems with which its organisation and the facilities at its research stations were specially fitted to deal. Notwithstanding these diversions, the Board has endeavoured to pursue systematically the main lines of its investigations into the causes and prevention of mining accidents, which work has an important bearing on the maintenance of the labour strength of the industry. The research stations at Buxton and Sheffield have been fully occupied during the year by work for the mining industry and for the various Defence Departments, as mentioned above. The report adds that reconstruction of the Buxton laboratories will be needed after the war, as the work has developed in directions for which the present lay-out is not adequate.

Parsons Memorial Lecture

The Parsons Memorial Lecture, which is delivered annually and in turn by ten societies, each of which is interested in one of the many-sided activities of the late Sir Charles Parsons, fell to be given this year before the Physical Society. Lord Rayleigh was the lecturer, and he chose, in delivering his address last Friday, October 15th, at the Royal Institution, to deal with Parsons' work on the making of searchlight reflectors and various other optical matters concerned with reflectors and lenses. He referred first to Lord Ross, Sir Charles' father, and other distinguished men with whom Sir Charles had associated in his youth, and who may have directed his thoughts towards optics. Coming to the production of curved mirrors, he pointed out that decorative convex mirrors were to be found in paintings of the early fifteenth century, so that their production went very far back. In reflectors of long focal length in relation to their diameter, a spherical form would produce a close approximation to a parallel beam. Such mirrors could be and were made by softening glass plates over a spherical former and polishing the resulting concave surface by contact with a spherical surface of the desired radius, giving the two a relative oscillating and rotary motion. Where, as in a searchlight, however, the diameter of the mirror was great relative to the focal length, it was necessary if a parallel beam was to be produced to form a parabolic surface, a problem of much greater difficulty. Sir Charles solved it by forming the "rough" surface in a way similar to that used for a spherical mirror, and then, depending upon the surface so formed to act as a guide, to polish with spherical blocks much smaller in area than the whole mirror that part of the mirror to which their radius of curvature closely corresponded.

The Production of War Equipment

In a speech made in London on Friday, October 15th, Mr. Duncan Sandys, Joint Parliamentary Secretary to the Ministry of Supply, disclosed the fact that we were now in a position to give continually increasing attention to the production of specialised types of equipment to meet new strategical requirements. Until not very long ago, we had concentrated mainly on the output of such basic items as guns and ammunition, but the task of supplying the Army with these staple weapons was now so well advanced that it had been decided to put increased emphasis on the production of invasion craft, cranes, bridging materials, locomotives, and other transport vehicles, as well as upon the many other items of equipment which were essential to the rapid movement of armies by sea, land, and air, and which were particularly necessary for big-scale amphibious operations. Mr. Sandys also spoke of an improved armour-piercing shell which we were now using against tanks, and said that the first outstanding development of this kind was the employment of capped shot. The usual armour-piercing shot, when fired over a certain velocity, sometimes shattered on striking the armour of an enemy tank. By fitting a special steel cap, it had been found possible at considerably increased velocities to hold the nose of the shot together long enough to allow it to begin penetrating the armour plate. It was necessary for these steel caps to have very blunt noses, which meant additional resistance to the projectile in its travel through the air. In order to overcome this, a pointed cap of light construction, which was destroyed on impact, was fitted in front of the armour-piercing cap.

Annual Report of the Chief Inspector of Factories

The annual report of the Chief Inspector of Factories, which has recently been issued by the Stationery Office for the year 1942, draws attention to the increased importance of women working in factories, shown by the large increase in the number of accidents to women and the increase in the accidents in the munitions industry, which was formerly reserved for male workers of some skill. It is stated that the increase in accidents is chiefly in connection with those accidents due to causes other than power-driven machinery. These accidents can be illustrated by extracts from two tables. That for the increase in 1942 over 1938 shows the following percentages:—Adult males, 51; adult females, 389; male young persons, 27; and female young persons, 34. It should be remembered that these figures do not give a true picture, because accurate figures of the numbers employed are not known. In the reportable accidents in the shipbuilding industry the number of accidents has increased as follows:—1938, fatal 57, non-fatal 9328; and 1942, fatal 116, non-fatal 19,132. Propaganda against such accidents has met with success in shipbuilding centres, and is being extended. As regards industrial health, the report of the Senior Medical Inspector of Factories states that industrial health remains satisfactory, but it is necessary to sound a note of warning as to what may happen in the coming winter. The Deputy Chief Inspector's report on hours of employment shows that there has been a tendency throughout the year to reduce hours.

The British Engineers' Association

The thirty-first annual general meeting of the British Engineers' Association was held at the Waldorf Hotel, London, on Thursday, October 14th. The meeting unanimously supported a recommendation by the Council that the scope of membership should be widened so as to include sectional trade associations whose members are primarily concerned with the mechanical engineering industry. Since the inception of the British Engineers' Association in 1912 membership has been restricted to individual firms, and some hundreds at present participate in the work which the B.E.A. undertakes. It is expected that the extension of membership which has been agreed upon will facilitate closer co-operation between those with mutual interests. At the meeting, the Director of the Association, Mr. A. W. Berry, M.I.E.E., outlined some of the services rendered to members and referred to the close contacts maintained by the Association with the appropriate Government Departments. He referred also to the successful outcome of representations to the Chancellor of the Exchequer in respect of Tax Reserve Certificates and to the submission by the B.E.A. of memoranda on the effects on productive industry of excess profits taxation. Lieut.-Colonel H. B. Riggall, of Ruston and Hornsby, Ltd., and Mr. W. D. Lancaster, of Hughes and Lancaster, Ltd., have been elected Vice-Presidents during the year. At a subsequent meeting of the Council, Mr. Cecil Bentham was thanked for his services during the past year and was re-elected President of the Association.

Salvage at Pearl Harbour

(By an American Correspondent)

No. I

THE efficient and, withal, expeditious work done at Pearl Harbour in repairing and salvaging the naval craft damaged there on December 7th, 1941, by the Japanese aircraft raid has well demonstrated that the attack, although a surprise one, was not unforeseen or unprepared for. Grim as the toll was that was taken at the time, probably nothing could have been done more to unify the American people and to speed up the strenuous task of really getting the nation to play its essential part in the worldwide conflict.

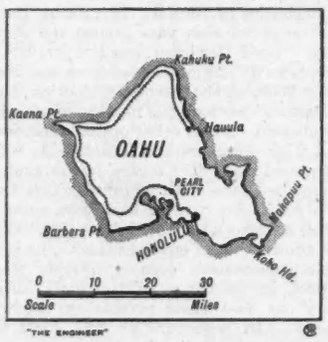
Before Japan struck at Pearl Harbour that naval base was but little known by the vast majority of the people of the United States, and relatively few had a true understanding of what Pearl Harbour might mean in defending the entire West Coast of the country and the Pacific approaches to the vitally strategic Panama Canal. The probably more than 100 million dollars spent without parade, and with little knowledge by the people at large, in developing and equipping that island stronghold, 2080 nautical miles distant from San Francisco, has been amply justified by what has been done there in the last eighteen months or so. Just how the Japanese caught the defending forces of the Hawaiian Islands off guard has not been disclosed as yet but the naval authorities have revealed much about the nature of the attack, the temporarily staggering damage done, and how rapidly the injuries inflicted were repaired and the majority of the ships made ready for any service that might be expected of them.

It is doubtful if the Congress that first appropriated for a naval base or coaling station in the Hawaiian Islands had the least conception of what might eventuate there in the course of years.

Origin and Development of the Harbour

King Kalakaua—the last of the Hawaiian kings—had so far an eye to business that he worked without cease until a treaty of commercial reciprocity was ratified between the kingdom of Hawaii and the United States in 1875. That treaty was of great advantage to the none-too-stable cane sugar industry of the islands, because it assured a ready and profitable market for a greatly amplified production. The treaty was for a specific term of seven years, but with the understanding that it could be renewed or extended by agreement. Either of the Governments concerned could terminate the treaty at the end of the seven years by twelve months' notice. When the time for action came, pro or con a renewal, many of the legislators in Congress—realising the disproportionate gains by the kindgom of Hawaii—were opposed to renewing the treaty unless the United States was to have some commensurate benefit, and the modified reciprocity convention was not ratified until early in December, 1887. By its terms the United States was granted the exclusive right to enter the harbour of Pearl River, in the island of Oahu, and to estbalish and to maintain there a coaling and repair station for the use of United States vessels.

Curiously, it was not at Pearl Harbour,* but in the port of Honolulu that the American authorities spent considerable sums later in equipping a coaling station and a naval hospital. This was done despite the smallness of Honolulu's harbour, which became emphasised during the Spanish-American War and the naval and military activities in the Philippines for some years following, when troopships and supply vessels made fairly regular stops at Honolulu on their outbound and homeward runs. Increasing trans-Pacific trade added to the crowded conditions at Honolulu. The Hawaiian Islands, on their own initiative, were annexed to the United States in August, 1898; and in 1901 Congress appropriated 150,000 dollars for the acquisition of land at Pearl Harbour for the creation of a naval station there and for the establishment of channel defences. That was really the first provision for following up the right acquired under the reciprocity convention concluded with the kingdom of Hawaii in December, 1887. What has been done at Pearl Harbour since aroused at first a gradual and later an increasing awakening



MAP OF OAHU ISLAND

to the vital importance of that harbour in any scheme of naval defence and operations in the Pacific.

The engineering work at Pearl Harbour as a base for the Pacific Fleet of the United States Navy went forward during the intervening years with a progressive stepping-up of the scope of those activities, and a great deal was being done at the very time of the attack in a feverish effort to round out and to amplify features that World War II had demonstrated to be necesssary. The entrance to Pearl River from the sea was at first possible only to vessels of shallow draught because of a coral reef extending seaward for a mile or more before water 25ft. deep was reached; and even after the bar was crossed the course of Pearl River continued to offer a very sinuous channel until deep water was found in certain sections of the land-locked lochs. Many millions of tons of coral rock had to be drilled, blasted, and dredged to open up an ample channel across the reef and to straighten the course up the river in order to accommodate the largest of battle craft should they return to port with more than normal draught because of injuries. Extensive water areas around Ford Island and adjacent to the Navy Yard and dry docks have been also deepened from time to time so that water should be available up to a depth of quite 45ft. All this, together with the building of immense graving docks under difficulties, the construction of machine and other shops, and the provision of other facilities, essential to a great naval base, have called for the expenditure of vast sums. Fortunately, all these improvements were in the main completed and others were well under way when the Japanese appeared over the island of Oahu on the morning of December 7th, two years ago.

The Pearl Harbour lochs have an east and west spread of a little more than 6 miles, and from Pookala Point, where the river branches eastward and westward, they have a north and south reach of about 3·9 miles. Ford Island, in the eastern half of the harbour, is the Navy's air base, and the ships that are not in dry dock or tied up at the water front of the Navy Yard at the adjacent mainland to the east are usually moored around this island in a double line, as was the case with many of the capital ships at the time of the Japanese attack. While this concentrated the target for the enemy, the arrangement fortunately served on that occasion to expose only the outer line to torpedoes launched from the hostile aeroplanes, but both lines of the moored ships were equally open to the attack of dive-bombers and horizontal bombers, which were used at various stages of the raid.

The Attack

The first evidence of approaching trouble was the discovery about 6.30 a.m. of a small submarine moving in the prohibited waters outside the harbour approach. That two-man submarine was promptly disposed of by a naval patrol aeroplane and the destroyer "Ward," one and a-half hours before the main attack by air. What followed is thus described in a report issued by the Navy Department:—

"At 7.55 a.m., on December 7th, 1941, Japanese dive-bombers swarmed over the Army Air Base, Hickam Field, and the Naval Air Station on Ford Island. A few minutes earlier the Japanese had struck the Naval Air Station at Kaneohe Bay (approximately 15 miles to the eastward and northward, on the east coast of the island of Oahu). Bare seconds later enemy torpedo aeroplanes and dive-bombers swung in from various sectors to concentrate their attack on the heavy ships at Pearl Harbour. The enemy attack, aided by the element of surprise and based on exact information, was very successful.

"Torpedo aeroplanes, assisted effectively by dive-bombers, constituted the major threat of the first phase of the Japanese attack, lasting approximately a half-hour. Twenty-one torpedo aeroplanes made four attacks, and thirty dive-bombers came in in eight waves during this period. Fifteen horizontal bombers also participated in this phase of the raid. Although the Japanese launched their initial attack as a surprise, battleship ready machine guns opened fire at once and were progressively augmented by the remaining anti-aircraft batteries as all hands promptly were called to general quarters. Machine guns brought down two and damaged others of the first wave of torpedo aeroplanes. Practically all battleship anti-aircraft batteries were firing within five minutes; cruisers, within an average time of four minutes; and destroyers opening up machine guns almost immediately, averaged seven minutes in bringing all anti-aircraft guns into action.

"From 8.25 to 8.40 a.m. there was a comparative lull in the raid, although air activities continued with sporadic attack by dive and horizontal bombers. This respite was terminated by the appearance of horizontal bombers, which crossed and recrossed their targets from various directions and caused serious damage. While the horizontal bombers were continuing their raids, Japanese dive-bombers reappeared, probably being the same ones that had participated in

* No good maps of Pearl Harbour have been published. The area was enclosed thirteen years before the war and the ban is now enforced more strictly than before.—Ed. The E.

earlier attacks; this phase, lasting about a half-hour, was devoted largely to strafing. All enemy aircraft retired by 9.45 a.m."

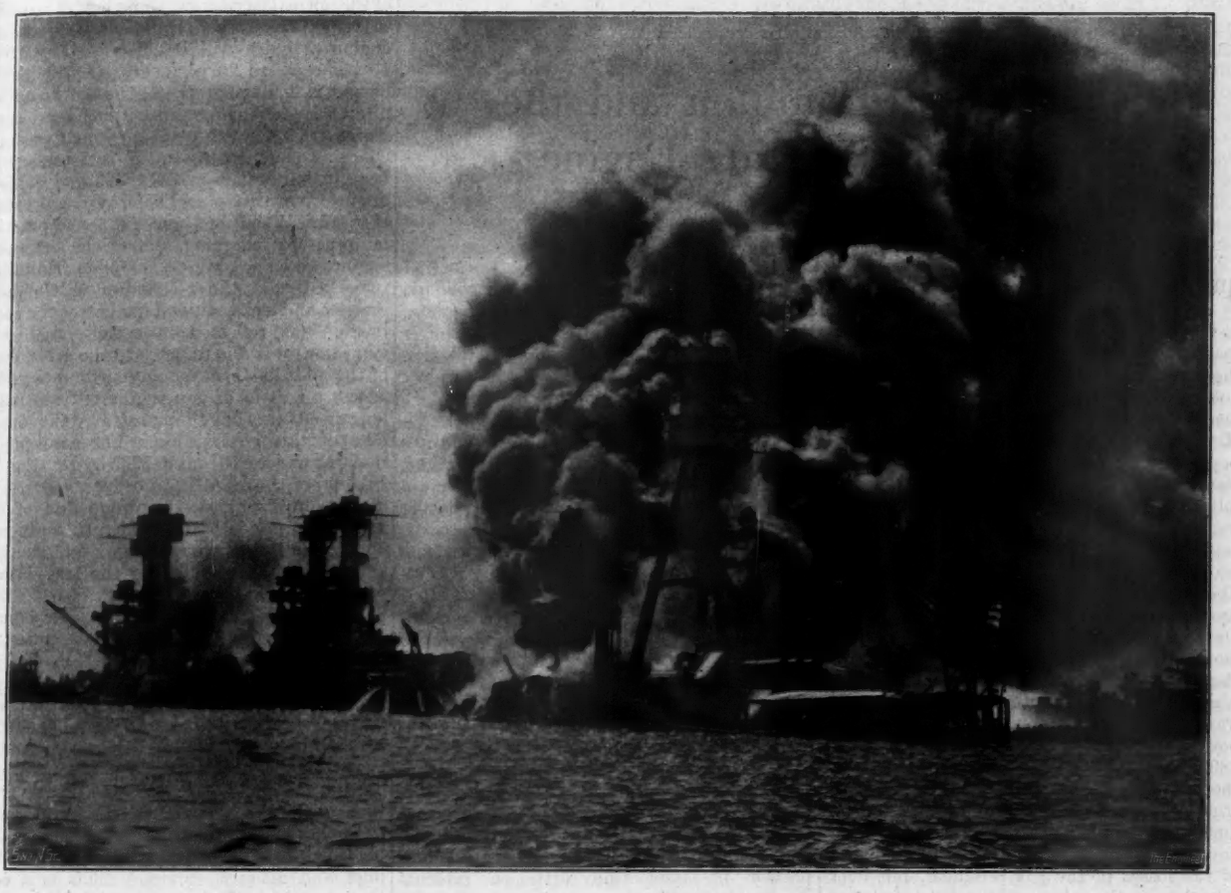
The strategy of the Japanese had been to attack both naval and army air bases and so reduce as far as possible any resistance aloft that might interfere with the centring of their main attack upon the heavy ships of the battle fleet. In this manœuvring the Japanese were very largely successful but they paid heavily for it. Let me quote again from the official statement issued by the Navy Department:—

"Prior to the Japanese attack, 202 United States naval aircraft of all types on the island of Oahu were in flying condition; but 150 of these were permanently or temporarily disabled by the enemy's concentrated assault—most of them in the first few minutes of the raid. Of the 52 remaining naval aircraft, 30 took to the air on December 7th, 1941, the other 14 being ready too late in the day or being blocked from take-off position. Of necessity, therefore, the Navy was compelled to depend on anti-aircraft fire for its primary defence weapon, and this condition exposed the Fleet to continuous air attack.

"By coincidence, 18 scout bombing aeroplanes, from a United States aircraft carrier, *en route*, arrived at Pearl Harbour during the raid. These are included in the foregoing figures. Four of these scout bombers were shot down, 13 of the remaining 14 taking off again in search of the enemy. Seven patrol aeroplanes were in the air when the attack started.

"There was a total of 273 Army aeroplanes on the island of Oahu on December 7th, 1941. Very few of these were able to take off because of the damage to the runways at Hickam and Wheeler Fields. Eighty naval aircraft of all types were destroyed by the enemy. In addition, the Army lost 97 aeroplanes on Hickam and Wheeler Fields. Of these, 23 were bombers, 66 were fighters, and 8 were other types.

"It is difficult to determine the total number of enemy aircraft participating in the raid, but careful analysis of all reports makes it possible to estimate the number as 21 torpedo aeroplanes, 48 dive-bombers, and 36 horizontal bombers—totalling 105 of all types. Undoubtedly certain fighter aeroplanes also were present, but these are not distinguished by types and are included in the above figures. The enemy lost 28 aircraft due to Navy action, and the Army pursuit aeroplanes that were able to take off shot down more than 20 Japanese aeroplanes. In addition, three submarines, of 45 tons each, were accounted for."



AFTER THE ATTACK ON PEARL HARBOUR: U.S.S. "WEST VIRGINIA" AND U.S.S. "TENNESSEE" DAMAGED AND U.S.S. "ARIZONA" SUNK

The Losses

When the Japanese struck, two surface-ship task forces of the Pacific Fleet were away at sea on assigned missions and two other task forces were at their base at Pearl Harbour following extensive operations at sea. Not counting small craft of different kinds, there were eighty-six ships of the Pacific Fleet moored at Pearl Harbour on the day of the raid. Included in that force were eight battleships, seven cruisers, twenty-eight destroyers, and five submarines. The condition of those vessels, when the smoke of battle cleared, was:—"As result of the Japanese attack, five battleships—the "Arizona," "Oklahoma," "California," "Nevada," and "West Virginia"; three destroyers—the "Shaw," "Cassin," and "Downes"; the minelayer "Oglala"; the target ship "Utah"; and a large floating dry dock were either sunk or damaged so severely that they would serve no military purpose for some time. In addition, three battleships—the "Pennsylvania," "Maryland," and "Tennessee; three cruisers—the "Helena," "Honolulu," and "Raleigh"; the seaplane tender "Curtiss," of 8625 tons displacement, authorised in 1937; and the repair ship "Vestal," 6625 tons displacement, launched in 1908, were damaged."

Although the foregoing nineteen vessels were either sunk or damaged, only one of that number, the "Arizona," of 32,600 tons displacement and launched in 1915, was effectually destroyed as a fighting ship. Sunk and woefully shattered, it has been possible to reclaim from her much equipment and a large tonnage of materials that could be utilised for service again or shipped to the United States as scrap for reworking. The "Arizona" was wrecked and sent to the bottom by a bomb that passed down her smokestack and detonated the vessel's forward magazines.

The battleship "Nevada," displacing 29,000 tons, launched in 1914, was the only capital ship that managed to get under way during the attack. She was headed seaward, but the Japanese attacked her fiercely in an effort to sink her and to block the channel. They failed in that attempt, because her captain backed her and beached her within the harbour where the task of salvaging her afterwards was simplified so that she might soon be fit again for sea. Of the eight battleships moored, side by side in pairs, at the piers jutting out from Ford Island, the outboard line was broadside on to open water and offered ready targets for torpedoes

launched from aeroplanes. The Japanese made the most of that situation and sank and extensively damaged the "Oklahoma," of 29,000 tons, launched in 1915, and the old "Utah," of 22,000 tons, launched in 1909 and serving as a target ship. These ships capsized as they sank and have since presented more difficult problems for the salvors than did the other capital ships that were sent to the bottom but remained upright.

The cruiser "Raleigh," of 7050 tons, launched eleven years ago, was both torpedoed and bombed, but by skilful handling was grounded and so kept from capsizing. The "Helena," of 10,000 tons, completed in 1939, was hit by a torpedo aeroplane, but so moderately damaged that she could be made well-nigh immediately ready for any service. The minelayer "Oglala," an ex-merchant steamer of 4200 tons displacement, and at the time of the attack serving as the flagship of the mine force of the Pacific Fleet, was lying beside the "Helena" when that ship was struck by the torpedo, and the detonation of that missile, by concussion, ruptured the hull of the minelayer and caused her to fill and to capsize. The seaplane tender "Curtiss" and the repair ship "Vestal" were struck by bombs a number of times, but were not much damaged. The large floating dry dock, which was sunk by bombing, was riddled with many small holes in its sides and two immense holes were made in its bottom. The small holes in the sides of the dock were plugged by divers so that the structure could be drained and refloated for very much-needed service. The bottom holes were closed after the dock was afloat and while in use.

(To be continued)

John Henry Hamilton and the Positive Scavenging Engine

By A. K. BRUCE

No. III—*(Continued from page 303, October 15th)*

THROUGH the neglect and apathy which are only too characteristic of British reluctance to give publicity to British achievement, the technical position of the British gas engine in the last decade of the nineteenth century has not been recognised. Such was this lack of recognition that Rudolf Diesel, replying on March 15th, 1912, to the discussion on the paper which he read before the Institution of Mechanical Engineers, could remark as follows: "Gas engines to-day were approaching in a few cases the efficiency of the Diesel engine, but it was not the case fifteen years ago, when the first Diesel engines were made. Then the efficiency of the first Diesel engine was nearly double that of the gas engine." Diesel was very far off the mark in this statement, since while, in 1897, the full-load brake thermal efficiency of the first Diesel engine which could be made to work satisfactorily was rather less than 26 per cent., Hamilton's positive scavenger gas engine designed in 1898 was proved to have a full-load brake thermal efficiency of 30·5 per cent. It is true, of course, that in the case of the producer gas engine the overall heat efficiency figure would need to be given with definition of the losses in the gas producer, but even allowing for these losses, Diesel's comparison is quite inaccurate. He was doubtless unaware of the fact that a British engineer had, in 1890, effected improvements in the scavenging of four-cycle engines which enabled him, by simple mechanical means, to charge the cylinder with the greatest possible weight of oxygen at a minimum expenditure of power in pumping the scavenging air.

Turning now to the development, during recent years, of Hamilton's positive scavenging system as a means of pressure charging the four-cycle engine, the first application in a marine installation appears to have been carried out in 1922, on the Burmeister and Wain type four-cycle engines of the M.V. "Tiradentes." The vessel had failed to reach her designed speed under service conditions, and the builders decided to overcome the difficulty by increasing the output of the engines. This increase was managed by means of an electrically driven blower, which, by supplying additional air for combustion, raised the output of each engine from 1550 I.H.P. to 1800 I.H.P. The induction pressure was increased from atmospheric pressure to 15·6 lb. per square inch absolute, the power required for driving the blower being 52 H.P. This was a simple adaptation of Hamilton's method, and it is now widely used both in land and marine practice.

It was not until March 21st, 1923, thirty-three years after the date of Hamilton's patent, that Alfred Büchi, of Winterthur, Switzerland, described and patented certain "Improvements in controlling and regulating a power plant combination consisting of an internal combustion engine to which the charge is supplied under pressure by a compressor driven by a turbine that is actuated by the exhaust gases of the internal combustion engine." Büchi did not claim the exhaust gas-driven turbo-compressor, since this device was already well known and had come into prominence during the war of 1914–18. It had then been used by Rateau and others for maintaining sea-level power in aircraft engines when operating at high altitudes. Büchi's patent (No. 213,243) relates to certain features intended to improve and to regulate the effects produced by the employment of an exhaust gas turbo-compressor in association with an internal combustion engine.

The first application of the Büchi arrangement was made during 1926, when an exhaust gas turbine driven blower was fitted to a four-cycle engine of M.A.N. type built by the Vulkanwerke, Hamburg, and installed in the German cruiser "Hansestadt Danzig." Whatever may be the total effect produced by the exhaust gas turbo-blower arrangement (or any other scheme of pressure charging), it must not be forgotten that an essential part of it is due to the positive scavenge. As recently as 1931 G. J. Lugt, of the Werkspoor Company, Amsterdam, remarked that a peculiarity of all super-atmospheric engines is the scavenging of the compression space at the end of the exhaust stroke by means of precompressed air. This is, of course, quite true, but Lugt goes on to say that "this, as a matter of fact, is a point which, as far as is known, was first made by Büchi himself. To achieve this, the overlap of the inlet and exhaust valves is made greater than is usual in atmospheric engines; the inlet valve opens earlier; the exhaust valve closes later; and the air from the receiver passes from the inlet manifold to the exhaust manifold through the cylinder, if the pressure in the former is higher than in the latter." It is fair to mention that Büchi expressly acknowledges, in his patent specification, that the scavenging of the cylinders of internal combustion engines is a known procedure "in order to obtain a lower temperature in these cylinders and to remove as completely as possible the exhaust gases otherwise remaining to some extent in the cylinders, and to obtain thereby a pure charge." Lugt overlooked this part of Büchi's patent specification, and he is by no means the only engineer who has failed to recognise the originator of the positive scavenging arrangement.

With the large compression ratio of the oil engine the influence of the scavenge on the output is not, of course, so high as in the case of the normal gas engine, though with positive scavenge alone the output of a given oil engine cylinder will be increased by from 15 per cent. to 20 per cent. If still higher output is demanded, then air must be added after the scavenging process has been completed. This is the point at which pressure charging commences, and it is necessary to bear in mind that pressure-charged engines are positively scavenged before being pressure charged. When, in about 1928, the practice of pressure charging four-cycle heavy-oil engines commenced to extend, Hamilton remarked that the restriction of the heat stresses and the sustained quality of the combustion (as reflected in specific fuel consumption) was due directly to the great mass of the additional scavenging air and the high excess air ratio of the engine. Tests made long afterwards have demonstrated the soundness of this observation. For example, a research was carried out in 1935 by Dr.-Ing. W. Pflaum, of the M.A.N., in order to ascertain, among other things, the proportion of the total air supplied by the Büchi turbo-blower which passed through the cylinder as scavenge air. In analysing the test data it was found that for a B.M.E.P. of 5·5 kilos. per square centimetre (78·2 lb. per square inch) the scavenging portion amounted to 18 per cent., while for a B.M.E.P. of 9·13 kilos. per square centimetre (129·8 lb. per square inch) the scavenging portion was 32 per cent. of the total air. The conclusion reached by the M.A.N. research engineer was that "the beneficial results of supercharging on combustion and heat stresses accrue from the additional scavenging of the cylinder with supercharge air on the exhaust T.D.C. obtained by using considerable overlap of the inlet and exhaust valves." This is a conclusion which had been reached by the originator of the positive scavenging system as long ago as 1890. Indeed, it is many years since tests made on positively scavenged gas engines of Hamilton's design showed mean indicator pressures of 115 lb. per square inch (8·085 kilos. per square centimetre) without exhibiting any of the normal indications of overloading. Maximum gas engine ratings with M.I.P. as high as from 125 lb. per square inch to 130 lb. per square inch (8·788 kilos. to 9·140 kilos. per square centimetre) were obtained.

Hamilton would have been glad to acknowledge that perhaps the first inventor to adumbrate the idea of pressure charging was that most ingenious Scottish parish minister, the Reverend Dr. Robert Stirling, who, in his famous patent for the hot air engine with regenerator (No. 5456 of 1827) proposed (claim four) the use of an air pump for forcing through the valves "a greater quantity of air than could be introduced by the simple pressure of the atmosphere." Dr. Stirling was not, it is true, dealing with an internal

combustion engine, and he did not need to consider the matter of scavenging the four-stroke engine. This, as has been shown, was left for solution by Hamilton, himself a son of the manse.

Much controversy has arisen in connection with the word "supercharging," the general conclusion being that the expression is misleading. As was pointed out some years ago by Lugt, "super" means "over," while charging means "loading," so that literally "supercharging" would be "overloading," which is a dangerous condition. Lugt preferred to call the normal engine an "atmospheric" engine and the supercharged engine a "super-atmospheric" engine. The expression "pressure-charged" is more convenient and sufficiently accurate for descriptive purposes.

While his invention of the positive scavenge is the parent of the class of developments called "pressure-charging" or, misleadingly, "supercharging," Hamilton was not an enthusiast for the practice of forcing up the mean effective pressure of the normal four-cycle engine by what he deemed excessive charging. Particularly did he object to the use of excessive maximum cylinder pressure as a means for increasing the output of engines employed for industrial as distinguished from military and other special purposes, where restriction of dimensions and weight might be imperative. It was not, as Hamilton maintained, in the interest of the commercial engine user to invite him to damage his engine, if of normal type, by harmful shock loading on pistons, bearings, and other parts. There was a point at which increase of output from a given cylinder size and speed could not be obtained except at the cost of increased wear and tear. Accordingly he preferred to keep within this limit and regarded its transgression as bad engineering or "commercialism speculating in design." Hamilton preferred to concentrate on (1) the effective expulsion of the residual products of combustion, (2) the charging of the engine cylinder with clean air, and (3) the maintenance of cylinder walls, pistons, and exhaust valves in a cooler condition than would otherwise be possible. These are, of course, advantages derived from pressure scavenging, and it need not be pointed out that the first of them is more marked in the case of gas engines than in oil engines, since, power for power the quantity of the products to be got rid of and the extent of the surfaces to be cooled are much less in the case of oil engines. For example, while the compression space in the normal gas engine is about 26 per cent., the compression space in the normal high-compression oil engine is only about 7 per cent., calculated to the swept volume of the piston. The second and third advantages apply to any internal combustion engine, since, apart from the importance of a charge of cool and undiluted air, the surplus scavenging air has the effect of so reducing the temperature of the internal metal surfaces that the air drawn in on the suction stroke will absorb less heat from the combustion chamber walls, piston, valves, &c. Obviously, reasoned Hamilton, if the products of combustion are replaced by air much cooler than these products and thus exceeding them in mass, and if, in addition, the air drawn in on the suction stroke is cooler, the engine performance will be improved. This is the immediate reason why Hamilton's gas engines operated at comparatively high compression pressure and indicated mean effective pressure without pre-ignition. Pressure charging, on the other hand, consists in raising the pressure of the air (or the mixture charge) in the cylinder of a four-cycle engine so that at the commencement of compression this pressure is considerably above that of the atmosphere and the mass of air in the cylinder at the end of the suction stroke correspondingly increased. It was Hamilton's opinion that, except for certain specific types and in order to maintain N.T.P. engine ratings at high altitudes, there was no sufficient inducement to design commercial engines (assuming normal material) to withstand the higher mechanical stresses due to greatly augmented M.E.P. and also the higher temperature stresses due to the considerably greater heat transmission through the cylinder walls, *i.e.*, any percentage increase in the heat of combustion must be associated with a corresponding increase in the heat transfer. If, as he once observed, it should be claimed not only that there is no increase in the heat transmission, but also that the thermal efficiency of the pressure-charged engine remained about the same as that of the normal engine, then all the extra heat must be in the exhaust, and the higher the M.E.P. the more important would be the problem of dealing with the exhaust. He appreciated, of course, that since the heat carried away by the pistons is more or less proportional to the mean effective pressure, the pistons of a pressure-charged engine must convey more heat than the pistons of a normal engine.

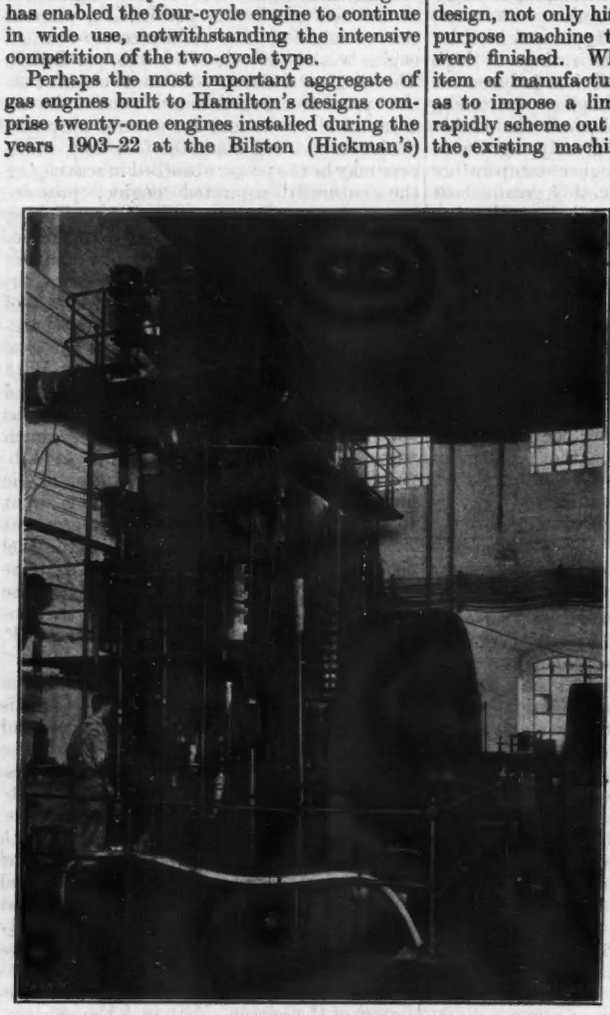
A pressure charging system for four-cycle engines which, developed by the Werkspoor Company, of Amsterdam, came into some prominence during 1929, is the so-called "under-piston" pressure charging, first applied on the engines of the twin-screw M.V. "Megara." According to this method, the bottom end of the cylinder in four-cycle single-acting engines is closed and fitted with valves to form a compressor cylinder. Many marine oil engines have been built with this arrangement, and in those of the "Megara" the M.I.P. was put up to as much as 10·5 kilos. per square centimetre (150 lb. per square inch), with a pressure charging pressure of from 5 lb. to 6 lb. per square inch gauge. Little information is available as to the thermal efficiency of such engines, when of slow-speed marine type, as compared with that of the larger normally aspirated engine of corresponding output and speed. Recently, however, E. S. Dennison and W. A. Morain published (American Society of Mechanical Engineers, 1941) particulars of comparative tests made on two four-cycle oil engines which, similar in a number of respects and designed for almost exactly the same output, differed, inasmuch as one engine operated with under-piston pressure charging while the other operated with normal aspiration. The designed output was 850–875 B.H.P., and both engines were manufactured by the Electric Boat Company, Groton, Conn. The engine with under-piston pressure charging had a B.M.E.P. of 109·5 lb. per square inch (7·69 kilos. per square centimetre) at rated output (850 B.H.P.). The naturally aspirated engine had a B.M.E.P. of 74·4 lb. per square inch (5·23 kilos. per square centimetre) at rated output (875 B.H.P.). The corresponding mean indicated pressures are 135·6 lb. per square inch (9·52 kilos. per square centimetre) and 89·6 lb. per square inch (6·3 kilos. per square centimetre). The speed of the pressure charged engine was 460 r.p.m., the speed of the non-pressure-charged engine being 330 r.p.m. The fuel consumption of the pressure-charged engine, at rated load, was 0·401 lb. per B.H.P. hour, whereas the fuel consumption of the normally aspirated engine, at rated load, was 0·350 lb. per B.H.P. hour. These consumptions correspond to thermal efficiencies (B.H.P. basis) of 34·4 per cent. and 40 per cent. respectively. The comparatively costly crosshead type pressure-charged engine was therefore considerably inferior, in economy, to the normally aspirated trunk piston engine, though the weight of the former engine was at the rate of 51·9 lb. per B.H.P., whereas the weight of the non-pressure-charged engine was at the rate of 76·6 lb. per B.H.P. The engine builders did not claim that the pressure-charged engine would be an economical power unit for general purposes. Such results bring home the fact that, whatever may be the power absorbed in scavenging the naturally aspirated engine, pressure scavenging absorbs a great deal more. Taking the engines tested by Dennison and Morain, the friction mean pressure (which includes power for compressing the supercharge air) was 26·1 lb. per square inch in the case of the engine with under-piston pressure charging and 15·2 lb. per square inch in the case of the naturally aspirated engine. With reduced loads the position of the under-piston pressure-charged engine—so far as concerns specific fuel consumption—becomes much worse. For example, at B.M.E.P. 41·4 lb. per square inch, the fuel consumption of the under-piston pressure-charged engine went to 0·443 lb. per B.H.P. hour, whereas at B.M.E.P. 40·8 lb. per square inch the fuel consumption of the naturally aspirated engine was 0·365 lb. per B.H.P. hour, an increase of only 0·015 lb. per B.H.P. hour on the consumption at rated full load with B.M.E.P. 74·4 lb. per square inch.

In connection with other practical research recently carried out in the United States, it is appropriate to mention here the paper read in 1941 by J. B. Harshman before the American Society of Mechanical Engineers. This describes, among other things, difficulties experienced with the exhaust gas turbo charging of five-cylinder oil engines and with the turbo-compressor itself. Referring to the last two installations made by the Stanolind Pipe Line Company, Harshman remarks that "about the only disadvantage actually encountered in the operation of the installations has been our inability to operate these units at loads below the original rated horsepower of the engine. Although the exhaust-driven turbine is supposed to compensate automatically for load variation, it appears that an excess amount of air is forced into the engine for the quantity of fuel consumed, which results in poor combustion. After operating at reduced loads for a few days it is necessary to remove the turbine rotor and clean out the carbon accumulations." He suggested that this difficulty be dealt with by the "provision of some method of regulation of air at low loads to ensure proper combustion."

These and other tests notwithstanding, there is, of course, an important field for the utilisation of the exhaust gas turbo pressure charging system on four-cycle engines, the onset of which system has been due largely to the competition of the two-cycle engine. Very extensive have been the applications on large marine engines and on oil-engined locomotives and railcars, in which particular services exhaust gas turbo charging has proved popular. In the case of the locomotive such time lag as there may be on the turbo charger does not operate as a drawback. R. Tom Sawyer, of the American Locomotive Company, speaking in the discussion on a paper already referred to, remarked as follows in reference to this matter of time lag: "In locomotive use, when the throttle is closed the engine is idling; when the throttle is opened quickly the engine comes up to speed, but the turbo charger does not come up instantaneously. There is a lag of three or four seconds. Oddly enough, that lag for locomotive use is just what we like."

Whatever the particular system or the particular application, it is appropriate to recognise that the development of proposals made in 1890 by an eminent British designer has enabled the four-cycle engine to continue in wide use, notwithstanding the intensive competition of the two-cycle type.

Perhaps the most important aggregate of gas engines built to Hamilton's designs comprise twenty-one engines installed during the years 1903–22 at the Bilston (Hickman's) Works of Messrs. Stewarts and Lloyds. Of these twenty-one engines, fourteen were supplied for driving electric generators and seven for driving blowers. With one exception, they are all of the positive scavenging type, and they all operate on blast-furnace gas. The largest of the engines has an output of 2000 H.P., two of this capacity being installed. These two engines are of the horizontal type with four single-acting cylinders. Each of them drives a blower having two vertical double-acting cylinders. The largest of the engines driving generators has a capacity of 1200 H.P. at 125 r.p.m.; this is the vertical engine with four double-acting cylinders illustrated. All the engines are of the four-stroke type and some of them have been working since the date of installation with approximately 100 lb. per square inch I.M.E.P. The aggregate capacity of the twenty-one engines is rather more than 17,000 H.P., and all of them remain in use. No less than fifteen of the engines have been working for thirty years or upwards, while three of the engines were put to work as far back as 1903.



1200 H.P. Four-Cylinder Double-Acting Engine

Hamilton's is one of the outstanding names in the history of the internal combustion engine, and while his fame rests mainly on the invention of the positive scavenge and on the impetus which he gave to means for increasing the output of the four-cycle engine, he was a singular example of the scientific man who is also a sound practical engineer. There was no mechanical problem which he would not tackle, whether it related to design or to manufacture. It was his custom to design, not only his engines, but the special-purpose machine tools on which the parts were finished. When the capacity of any item of manufacturing equipment was such as to impose a limitation, Hamilton would rapidly scheme out the general design so that the existing machine tool equipment might suffice for dealing with the components of the engine. It was this amazing *flair* for arriving at sound mechanical solutions (often within the limit of restricted workshop facilities) which led him to the evolution of original arrangements, not only in respect of engines, but in respect also of the parallel operation of gas engine driven alternators, the mounting of alternator field systems, and the technique of rim fastenings in heavy fly-wheels. Informed with wide technical knowledge as well as singular mechanical intuition, Hamilton frequently apprehended, without preliminary experiment, those procedures which are often arrived at only as a result of protracted research. He may be said to have combined in himself the functions of research, design, and manufacture, and he had an uncanny eye for the detection of fallacies.

Among other things, Hamilton was a specialist in restricting the area of all cooling surfaces in contact with the hot gases. A scientific man, he could approach the matter of combustion chamber contour in a scientific way. No one better understood the significance of the spherical shape as applied to combustion chamber and clearance space. He had a complete understanding, not only of the factors which rendered the large gas engine more economical than the small engine, but of the mechanical means whereby these factors could best be managed. The earliest of his four-cycle gas engines, built in 1899 by Wells Brothers, is conspicuous for the ingenuity with which he contrived the position of the valves in such a way as to arrive at the least possible cooling surface relatively to combustion chamber volume. These very early engines were fitted with an inertia governor, the governing and admission arrangements being such that the quantity could be reduced before cutting the gas off altogether.

While some of his designs were audacious, they were never fantastic, nor did he originate what are called "mechanical curiosities." From the outset he adopted the plan of casting the breech end with the cylinder liner, eliminating the bolted joint and arriving at a combustion chamber design remarkably free from discontinuities of structural thickness. This arrangement persisted when he commenced the construction of heavy-oil engines working with direct injection, and it remains to this day the standard practice of the company with which he was for so long identified.

In the design of the pistons for large engines Hamilton employed, from the commencement, the plan of bolting the gudgeon pin to the piston, thus eliminating the heavy gudgeon pin bosses and large holes in the piston which are required in the normal design. His pistons, whether water-cooled or air-cooled, were always made with a view to the greatest possible symmetry, and in 1928 he patented (No. 315,965) a trunk type piston embodying features which, devised specially for use in *vis-à-vis* engines, have since been widely adopted.

In bringing to an end this short account of the work of a great British engineer, it is fitting to quote from the last letter written by John Henry Hamilton to the present writer. After describing a design for a large two-cycle marine oil engine, the letter concludes with the following words: "This and other oil engine matters, I think, will find me enough work and interest to prevent the time hanging heavily. I could not relinquish work altogether, and whether anything results from it or not, it will give me pleasure while my health lasts." He died not long after at the age of seventy-four, active almost to the closing day of his life of incessant activity.

Regional Water Supplies and Main Drainage

In connection with the Practical Planning Exhibition, organised by the Institution of Civil Engineers and the Institution of Municipal and County Engineers, a Conference on "The Development of Regional Water Supplies and Main Drainage" was held at the Institution of Civil Engineers on Wednesday, October 13th.

Miss Horsbrugh, M.P., Parliamentary Secretary to the Ministry of Health, opening the Conference, said she thought there was general agreement that there were at present too many individual water undertakings and too many sewage disposal undertakings. There were about 1100 water undertakings, and there would be general agreement that they should accelerate the process of combining or grouping some of those undertakings. That suggestion was made in order to get greater efficiency, and not merely for the sake of saying it was better to have a fewer number than 1100. They had to attack the problem first from the point of view of efficiency, and to get the size of the undertaking and the area of the undertaking arranged with a view to economic and technical efficiency. They did not want the undertaking to be too small for really skilled supervision. At the same time there were disadvantages if the undertaking was too large. The Government's Central Advisory Water Committee under Lord Milne, which published its First Report in 1938, had provided a good deal of material for discussion. It went further than

the actual water-supplying industry. They discussed the allocation and organisation of water supplies. That report also pointed the way to more regional planning and further amalgamation of units, and suggested further legislation to strengthen the Regional Water Advisory Committees. It considered legislation might be necessary if voluntary methods were not sufficient. The Water Undertakings Bill was coming before the House of Commons and that gave power to the Minister of Health to clothe with sanctions the arrangements that had been entered into under a voluntary basis. No doubt many members of the Conference would be putting views forward as to whether it was better, if possible, to reach some agreement on a voluntary basis, and then, as it were, have that clothed by the sanctions of the Ministry of Health, than to go in for a compulsory system throughout.

The sewage disposal units were in many cases too numerous, and they should look again and see whether there should be some amalgamations or other schemes brought into use. There, of course, they had some experience to go upon, because in the case of sewage disposal units the powers already existed for combining as between local authorities, and they had not to go to Parliament for any more authority for that. They had the experience of certain working in that regard; for example, the West Middlesex scheme. What should be the optimum unit from the technical point of view, both for administration and for the concentration of the plant? The two things need not necessarily go together. There need not be full centralisation.

Mr. J. S. Haseldine remarked that Miss Horsbrugh had said there were far too many water undertakings. He thought that really the problem of water supply in this country fell quite definitely into two parts—the question of distribution, on the one hand, and the question of resources, on the other. They should consider whether they did not think that so far as distribution was concerned, the collection of rates, the day-to-day contact with the consumer, was a parochial matter which was best done by small units. Where there were very big water undertakings their local distribution was decentralised, and it would always have to be decentralised.

The question of resources was an entirely different problem. Immediately a water undertaking went for powers to sink a well or put a dam across a river or take water out of a river, they all knew what happened. Company fought company, urban authority fought urban authority and company, and the county council fought the whole lot. The question of county boundaries or any other local government boundary, in connection with water resources in this country, was, of course, quite ridiculous. The majority of engineers would say a watershed or a group of watersheds was the proper area or region for the consideration of water resources.

Regional Water Advisory Committees were started in 1924, and there were some nine of them in existence to-day. Within the limits in which they were able to act, a number of them had done very good work. They had no statutory powers. Their areas might or might not conform with watersheds, and they had to face a considerable amount of difficulty, with no funds and no method of compelling anybody to join their Regional Committee. In fact, the formation of a Regional Committee in an area might be postponed for many years if one or two undertakings in that area would not play. Could the proposed River Boards, as recommended by the Lord Milne Committee, if properly constituted and having a proper water department, take over and carry out the work which Regional Water Committees were intended to carry out? If so, the problem awaited the formation of those Boards. But how long would they have to wait for them? Judging by experience, it would be twenty or thirty years.

In the gas industry they had instituted a number of companies called holding companies, which held the controlling interest in a number of undertakings, the undertakings being generally in one geographical area. By holding that controlling interest, they ran those undertakings with the maximum efficiency. The best works were run to their optimum capacity and the inefficient works were closed down in the summer and were only used in the winter time to meet the extra demand. If the water industry was left to itself, was it possible some such scheme as that might be the solution to the conservation of water in this country and its proper use? Holding companies might own all the resources in the particular region of operation, and sell the water in bulk to the existing undertakings, who would distribute it. If that could not be done by voluntary methods, were we not heading towards the formation of Regional Water Supply Boards, which would own possibly the whole of the water undertakings—distribution as well as resources? If, however, it was felt that distribution was a separate matter from resources, those Boards might well own all the resources and be bulk supply boards.

Whatever form of regional control we had for water supplies there must be cases of dispute cropping up from time to time between regions, and there might be cases where regions were not operating as they should operate. He thought they ought to turn their minds to the question whether the time had not arrived when there ought to be some body at the top which would go into the whole question of national water supply, and which would see that the regions did their jobs properly, and would advise Parliament and the Government and the parties thereon.

Mr. D. M. Watson remarked that the control of any specific river must be in the hands of one body instead of a number if the best results were to be obtained, but when they reflected that the control was not usually in the hands of one body, but in many hands, they began to look askance at our present methods. Those methods consisted in leaving that control to a number, and it might be a very large number, of local authorities who together held jurisdiction over the whole of the catchment area. Such a system was palpably faulty, but to be just to it they must recognise at once that, taken by and large, it had in the past produced tolerably good results. Unity of control would eliminate those differences which existed between one sewerage system and another in design or in operation, which might be serious enough to result in deterioration of the purity of a river.

But regionalisation must not be understood necessarily to mean centralisation of plant brought about by the laying of trunk sewers to discharge sewage to one collecting point, where large new sewage works on most modern lines would be constructed. In its ultimate state it might mean that. In any highly urbanised watershed that was probably the ultimate ideal. But where the majority of the sewage works serving an area were reasonably fit for their duty, where development was not overtaking the capacity of the sewers and the sewage works too fast, or where the sewage works were few and scattered, it was quite possible that the right course for the regional authority would be to provide for the convergence to one form of control of the existing systems of sewerage and sewage purification. Much could be done by such uniformity brought about by unity of control.

When it was found, however, with the existing systems that either sewerage or sewage purification, or both, were beginning to fail in the satisfactory accomplishment of their functions, then the regional authority would have to seek the best way of spending money to ameliorate those deteriorating conditions, and the centralisation of sewerage and abandonment of old sewage works in favour of a smaller number of larger works should certainly be raised at least for very serious consideration.

The advantages of the large central sewage purification plant, as opposed to the larger number of small scattered works, were many. Fewer sewage works meant a smaller area occupied by them; the release of land formerly occupied by sewage works could be an asset of considerable importance to any locality; there was undoubtedly greater economy in operating large sewage works than in operating small ones.

Trade wastes from manufacturing premises were frequently a source of considerable trouble to purifiers, having properties inhibitory to normal biological methods, yet mixed with domestic sewage in only reasonable quantities they might be amenable to ordinary treatment without recourse to extraordinary and more expensive methods as might otherwise be the case. It was invariably found that the larger the system the greater the number and volume of troublesome trade wastes which could be treated without the application of special treatment methods.

It was difficult in a few words to state how the sewerage of the smaller district contributing to such a large co-ordination of systems would benefit, but engineers had only to think of the many cases they knew of sewage being pumped from one watershed into another merely because the local authority's area peeped over the ridge. In some instances that pumping was avoided by duplication of the local authority's sewage works, in itself an objectionable alternative.

It must not be thought that such large co-ordinations were necessarily expensive, because experience had proved the contrary. In some instances they would be necessitated by future development, which, though not apparent at the moment, could not be served economically by patchwork additions. But the artificial boundaries of local authorities bore no relation whatever to drainage, which was really a problem seeking for its fulfilment at least the same conditions as Nature had provided for it. The smallest unit of area which could therefore be considered as correct was the catchment area of a river.

Mr. A. H. S. Waters said that in the immediate pre-war years much was being done in the way of sensible collaboration between local authorities and very considerable administrative improvement was being evolved. To that end county councils by wise exercise of their powers of direct financial assistance had largely contributed. The institution of regional administration for purposes primarily of home security had, however, given rise, not only to a passion in some quarters for regionalisation—as distinct from rationalisation—as a solution of all administrative problems, but to a feeling in the minds of many, if not most, local authorities that changes in constitution of far-reaching importance were inevitably to be thrust upon them, with the result that there had been, on the one hand, a somewhat hurried taking up of defensive positions by

various associations not yet quite agreed within themselves nor with each other, and, perhaps less overtly, but none the less apprehensively, by very many of the smaller local authorities, inspired possibly by the instinct of self-preservation; and, on the other hand, a preparatory casting around by certain larger local authorities for—to use the word without its acquired sinister application—living space. It was within the knowledge of many present that a most unfortunate condition of suspicion and apprehension obtained in local government at the present time which should be allayed, as soon as possible, by some pronouncement of its intentions by the central government, if even the pre-war standard of mutual confidence was to be fully restored.

Alderman Harold White considered that as far as regional water supplies were concerned, Mr. Haseldine had met the matter correctly when he said there were two branches of that subject, namely, water resources, where the water came from, and distribution. Frankly, he could not see that an authority in London, set up by any Government whatever, or by the Ministry, could possibly properly supervise the distribution of water in the various areas in this country. He could speak for water suppliers who controlled at present 71 million gallons of water per day, and he was against any Ministry which was going to try and interfere with what they had always said was a well-managed undertaking. They had always been willing to help every authority on the line of route with water at approximately cost price in bulk, but never entertained the idea of taking on distribution in the other boroughs.

Mr. Godfrey Taylor thought that the chief points which could be brought against water undertakings were that there had been first, some lack of co-operation in regard to the sources of supply; secondly, there had been a great lack of enthusiasm in obtaining statistical information; and thirdly, there was still a lack of a fully piped supply to some rural areas. On the whole, however, both local authorities and water companies had carried out their duties in a most efficient manner, and a very large percentage of our population had been supplied with an ample quantity of water for domestic use of an extremely high quality. Lack of co-operation appeared to be one of the principal defects in the past which post-war planning should endeavour to remedy. But he did not think that the recommendations of the Third Report of the Central Advisory Committee in any way suggested the setting up of any body which would ensure that co-operation between neighbouring authorities should take place where it did not exist to-day, and it was therefore desirable to consider the main causes of lack of co-operation in order to ascertain what could be done in the way of post-war planning to ensure that the resources of a particular area were allocated in a fair and proper manner among the undertakers concerned.

The Third Report of the Advisory Committee proposed that the water interests of the country should be divided into twenty-nine River Boards, and the Boards should control pollution, fisheries, land drainage, the conservation and abstraction of water, and navigation. Such a Board might be a suitable body for controlling and conserving water used for domestic supply where the water had been extracted from a river, either by means of impounding reservoirs or intakes direct, but where the water was obtained from underground sources the area should be governed entirely by geological considerations, and not by watershed considerations at all.

He also felt that the areas suggested in the Third Report of the Advisory Committee were too large and unwieldy to deal with the question of co-operation in congested areas.

Whatever form regional control was to take, it should not be based on vast water-shedding areas, but rather on industrial areas within the particular watershed if the supply was taken from the river, or entirely dissociated from watershedding areas if the supply was taken from underground sources.

Mr. Porteus pleaded for some expedition in the evolution of any plans which were going to be put forward by the Government for a reconstitution of the water supply system of this country. The Post-War National Development Committee of the Institution of Civil Engineers presented a report about a year ago, from which they would learn that in the sphere of sanitation and water supply alone there was no less than £61,000,000 worth of new capital works contemplated for execution in the six years immediately after the end of the war. If it were discovered that those contemplated works were not in accordance with the new plan, if there was to be a new plan of the Government, the waste of labour and money and human endeavour involved did not bear contemplation.

Referring to the Inland Water Survey Committee, he said, though it was appointed by the Government in 1934, it was itself far from satisfied with the progress it had been able to make in the collection of data. It had had to attempt to tackle a very formidable task without any form of statutory powers to demand information or expenditure for procuring that information. Obviously, they could not hope for success until such statutory powers were forthcoming. If they were to have a central water authority or water commission or what you will, that duty of collecting statistics and records might more appropriately be undertaken by that authority.

Mr. A. E. Blackburn (engineer and general manager of the Sunderland and South Shields Water Company) submitted for consideration a solution for regionalisation which consisted of a statutory central water authority to be regarded as a supreme rivers authority, and a rivers board for each of the fifteen regional areas covering the whole of England and Wales, each rivers board to function under the supervision of the central water authority.

Some large water undertakings regarded regionalisation with suspicion, and as likely to interfere with their autonomy and their works constructed and enlarged over many years, of which they were justifiably proud. Such fears were, he considered, groundless, as the larger water undertakings must necessarily take the lead in any scheme of regionalisation for extending the boon of an ample water supply to all parts of each region.

Mr. Cotterell did not agree that waterworks and sewerage were separate subjects. Any problem concerned with sewerage was really the result of water supply, and at the same time the disposal of sewage might very seriously affect the water supply. Both problems must be considered side by side, and one must follow the other.

In town-planning schemes he was afraid that very little consideration was given to the necessity for sewerage and sewage disposal. The obvious thing was that sewerage, if it was going to be economically carried out, depended upon the general contour of the country and the possibility of suitable sites for sewage disposal and the final disposal of the effluent. Those considerations should be taken fully into account at the outset, before the zoning of the area for a particular purpose was decided on, because it was one of the most important features, and could not easily be changed to suit a scheme planned on another basis.

The Iron and Steel Institute

At the Autumn Meeting of the Iron and Steel Institute, held at the offices of the Institute, 4, Grosvenor Gardens, London, S.W.1, on Thursday, October 14th, the President, Mr. James Henderson, announced that the Council at their meeting that morning had decided to nominate Mr. Arthur Dorman to succeed him as President of the Institute. Apart from his association with Messrs. Dorman, Long and many other companies, Mr. Dorman is a Vice-President of the Federation of British Industries, Past-President of the British Iron and Steel Federation, and of the National Confederation of Employers' Organisations.

The Secretary announced that a Carnegie Scholarship of £150 had been awarded to M. S. Wang (Sheffield University) to assist in a research on the effect of repeated heat treatment on steels.

In calling upon Mr. J. H. Whiteley to present his paper on "A Study of Austenitic Grain Growth in Medium-Carbon Steels," the President referred to the fact that at the Annual Meeting of the Institute last May Mr. Whiteley was awarded the Bessemer Medal, and Mr. J. H. Whiteley said that he was glad of that opportunity to apologise for his absence at the last meeting. If he had had any inkling of what was going to happen, he would have made the most strenuous efforts to be present; but it never occurred to him that his work would be considered to be of sufficient value to merit that award, and it had exceeded the height of his ambition. He then, following some good precedents, gave one or two incidents from his life.

Presentation of Papers

The following papers were presented for oral discussion:—"A Study of Austenitic Grain Growth in Medium-Carbon Steels," by J. H. Whiteley; "The Structure and Segregation of Two Ingots of Ingot Iron, One Containing Lead," by L. Northcott and D. McLean, jointly with "Leaded Manganese-Molybdenum Steel," by T. Swinden; "The Solidification and Cooling of Steel Ingots: Notes on an Examination of Three Typical Ingots," by E. F. Law and V. Harbord; "The Physical Chemistry of Open-Hearth Slags," by J. White.

A Study of Austenitic Grain Growth in Medium-Carbon Steels

Discussion

Dr. C. H. Desch, F.R.S. (Vice-President), said that one fact which came out clearly was that by high-temperature heating an inherently coarse-grained steel could be converted into one having similar properties to an aluminium-treated steel. That was of considerable importance. In the last part of the

paper the author showed quite clearly that the effect of aluminium was not due to aluminium in solid solution.

There was, he thought, a possibility that very fine intercrystalline films might play a considerable part, and they are of such a character that they cannot be seen by microscopical examination under ordinary powers.

Dr. T. Swinden (Central Research Department, the United Steel Companies, Ltd., Stocksbridge, near Sheffield) welcomed the paper very heartily. The work appeared to be in full support of the hypothesis that the carbide size was at least a very important and controlling factor, but the question still remained of why the addition of aluminium affected that. He hoped that Mr. Whiteley would continue this work, with a view to explaining further the obvious effect of aluminium in controlling the growth of grains on reheating beyond the Ac_1 point.

Dr. A. McCance (Uddingston, Lanarkshire) suggested, whilst the author's results are plotted on the basis of numbers of grains per square inch, it would be more convenient technically to report them in terms of the area per grain size.

Mr. A. U. Huddle (Cambridge) said that the paper seemed to lead to the view that the carbide form was one of the controlling factors. With regard to its effect on grain growth, he did not know what was the solubility of manganese carbide or aluminium carbide in austenite, but if it was low that would explain several of the phenomena to which the author referred in his paper.

Author's Reply

In his reply, the author said that he did not feel inclined to continue the investigation; he had had enough of it after seven years.

"The Structure and Segregation of Two Ingots of Ingot Iron, One Containing Lead."

"Leaded Manganese-Molybdenum Steel"

A paper by L. Northcott and D. McLean on "The Structure and Segregation of Two Ingots of Ingot Iron, One Containing Lead," and another by T. Swinden on "Leaded Manganese-Molybdenum Steel," were discussed jointly. The object of the first paper was to determine the segregation in a low-carbon steel ingot containing lead as compared with a similar ingot free from lead, and the second deals with tests on material from a non-leaded and a leaded ingot of manganese-molybdenum steel in order to determine the effect of lead (0·19 per cent.) on the mechanical properties, including machinability.

Mr. W. B. Wragge said that the authors of both papers apparently assumed that lead-bearing steels showed materially improved machining characteristics, and he gave some figures that substantiated that view.

Continuing, he noted that Dr. Swinden mentioned that standard Losenhausen machinability tests showed that the leaded steel had better machinability than the non-leaded steel to the extent of 38 per cent. The Losenhausen machine measured tool pressures in three directions, so that that figure of machinability was based on a pressure index. On a manganese-molybdenum steel the difference in energy consumption, measured by the pressure of the tool, as determined by himself on the Oxford Airey machine, similar in type to that used by Dr. Northcott and Mr. McLean, worked out at 17 per cent., instead of the 38 per cent. given by the Losenhausen machine. The *Journal* of the Institution of Production Engineers explained more or less why there may be a difference in the results obtained by energy consumption measurements, as compared with, say, a Losenhausen figure. He then passed on to a long discussion on various points raised in both papers.

Dr. T. Swinden said they were indebted to Dr. Northcott and Mr. McLean for their paper, which represented the first publication, so far as he was aware, of a detailed study of the distribution of lead in a rimming steel ingot. He was struck by the large amount of lead which was added, which he estimated at about 1·05 per cent., the resulting analyses showing a recovery in the region of 30 per cent. That contrasted with the addition which steel makers were making to killed steel, where the recovery was of the order of 80 per cent. He imagined that when adding lead to ingot iron the fume problem would, as a result, be much more acute. He observed that Mr. Wragge was in a unique position to contribute information on machinability, and he looked forward very much to the further data that he had promised to provide.

Mr. C. S. Graham (Scunthorpe, Lincolnshire) said that the authors drew attention to the high copper content in the ingot iron. They had found at Scunthorpe that when lead was added to ingot iron with copper a certain amount of the copper dissolved in the lead. He should expect, if the authors analysed the lead from that particular ingot, that they would find the copper content to be 0·04 per cent. They did not find that the addition of lead to rimming steel interfered with the rimming properties of the steel. From tests of the final billets, it appeared that the lead had no effect on the rimming at all, and he suggested to the authors that they subject the two ingots, with and without lead, to oxygen determinations, to see whether or not the lead had removed any of the oxygen in the steel.

Mr. J. H. Whiteley (Consett, Co. Durham) said that there were one or two points in Dr. Swinden's paper which were of interest to him. He mentioned that the addition of lead increased the grain size somewhat, there being a grain size of 6 to 7 in the non-leaded and of 4 to 6 in the leaded steel. He wondered whether the lead had washed some aluminium out of the steel. Lead and aluminium seemed to be soluble to a certain degree at a very high temperature, such as the temperature of liquid steel. He had found that there was a 7 per cent. solubility of aluminium in lead at 1500 deg. Cent., and it might be that when the lead was added to the mould it washed some of the aluminium out and so caused a rather coarser grain size. What happened to the lead afterwards no one knew. He himself had done a little work on the problem by heating specimens of leaded steel in a neutral atmosphere at 400 deg. Cent., and the beads of lead oozed out on to the surface. If those beads were flattened and then the sample was etched with cupric oxide, the lead was not attacked by nitric acid or any ordinary acid-etching reagent, and one could bring up the grain sizes and not have the lead present, whereas if the lead dissolved in the reagent one could not see where it was. He tried that method of etching the steel, first with chromic acid and then used the ordinary reagent, and he could not spot the lead anywhere. It was invisible, and further work by others had arrived at the same result; but he was inclined to think that if the lead did wash the aluminium out it was done when the lead was added, and before it was distributed in very fine form.

Mr. J. Woolman (Brown-Firth Research Laboratories, Sheffield) said that in the paper by Dr. Northcott and Mr. McLean there were certain anomalies in the distribution, and particularly the lead distribution, which required a certain amount of explanation. They found, for example, that the lead was highest at the bottom outside of the ingot, where figures as high as 0·71 per cent. were reported, whereas the general average of the ingot appeared to be somewhere about 0·3 to 0·35 per cent. That was rather strange, because there one would expect to get rather the average of the ingot, on account of the very rapid chilling effect, and one wondered where the rest of the lead had gone to. Dr. Swinden's paper contained a mass of very useful data. It was usually considered that possibly the free-cutting properties were due to the lubricating action, as it were, which the lead produced on the surface of the steel as it was being cut, but it seemed to be possible to provide a much better explanation, namely, the lower ductility at the high temperatures to which the surface of the steel was subjected during the machining operation.

The next paper was on "The Solidification and Cooling of Steel Ingots," by Messrs. E. F. Law and Vernon Harbord.

Dr. J. H. Whiteley, opening the discussion, said that he had read the paper through two or three times because there was scarcely a sentence in it with which he agreed.

On the other hand, Dr. C. H. Desch said that he saw the work when it was being done some years ago, and the plan of making a detailed microscopic study of a section right across the ingot was good. It would have to be developed and applied more frequently. There were certain changes in the microstructure, not merely in the macrostructure, which would have to be accounted for. Since the paper was prepared, the Ingot Committee had had other examples of similar changes in structure not accounted for by columnar and equi-axed crystals. Having examined the original photographs which the authors prepared, which showed more than the reproductions did, he thought they had very good evidence for assuming a difference between the stringers and the ordinary films of cementite. He suggested that a detailed study of sections right across an ingot of this kind would bring to light many unsuspected differences between different parts of the ingot. He knew that the authors had not had an opportunity of following up the work as they would like to do, and they were not dogmatic about their conclusions. They had put forward something which could be discussed, and he hoped that other ingots would be examined in similar detail.

The last paper was a very long one on "The Physical Chemistry of Open-Hearth Slags," by Dr. James White, of the Royal Technical College, Glasgow. The discussion was highly technical and difficult to follow, and those who are interested are advised to await the edited report in the "Transactions" of the Institute.

Automobile Research Committee.—At the quarterly meeting of the Automobile Research Committee of the Institution of Automobile Engineers, held at Caxton Hall on October 13th, Mr. John Shearman, M.I. Mech. E., M.I.A.E., road motor engineer of the L.M.S. Railway, was re-elected Chairman of the Committee for the year 1943–44, and Mr. A. G. Benstead, M.I.A.E. (Rotax, Ltd.), was re-elected Vice-Chairman. The election of sub-committees dealing respectively with research and general administration was carried out, and reports were presented showing the progress of researches at present in hand and the growth in the membership, the number of affiliated firms now being 364. Lieut.-Colonel J. A. Cole, who recently retired from the position of managing director of Humber, Ltd., and who had represented that firm on the Committee since its inception, was co-opted as a member.

The Engineer

OCTOBER 22, 1943

Vol. CLXXVI No. 4580

Contents

THE ENGINEER, October 22nd, 1943 PAGE

A SEVEN-DAY JOURNAL ... 317

LEADING ARTICLES—
JET-PROPELLED AIRCRAFT ... 326
UNFOUNDED ASSERTIONS ... 326

SPECIAL ARTICLES—
ENGINEERS AND THE BRITISH EMPIRE. No. XVI. (Illus.) ... 329
IRON AND STEEL INSTITUTE ... 324
JOHN HENRY HAMILTON AND THE POSITIVE SCAVENGING ENGINE. No. III. (Illus.) ... 320
REGIONAL WATER SUPPLIES AND MAIN DRAINAGE ... 322
SALVAGE AT PEARL HARBOUR. No. I. (Illus.) ... 318

CANADA AND CIVIL AVIATION ... 334
HOWRAH BRIDGE. (Illus.) ... 333
INVENTORS AND EMPLOYERS ... 332
WORKS EXHIBITION ... 328

LETTERS TO THE EDITOR—
"BOONDOGGLING" ... 333
"THIS FREEDOM" ... 333
BOILERS OF THE "BISMARCK" ... 333

OBITUARY—
G. L. ADDENBROOKE ... 327
ENGINEER COMMANDER P. W. SILLINCE ... 327
DR. W. H. HATFIELD ... 328

NEWS AND NOTES—
FORTHCOMING ENGAGEMENTS ... 336
MARKETS, NOTES AND NEWS ... 335
NOTES AND MEMORANDA ... 336
SIXTY YEARS AGO ... 334
SOUTH AFRICAN ENGINEERING NOTES ... 333

NOTICES TO READERS

Paper restrictions make it impossible to increase the number of subscribers. New subscriptions can in future only be accepted for inclusion on the waiting list.

The fact that goods made of raw materials in short supply owing to war conditions are advertised in this paper or described in its editorial columns should not be taken as an indication that they are necessarily available for export.

*** *If any Subscriber abroad should receive* THE ENGINEER *in an imperfect or mutilated condition, he will oblige by giving prompt information of the fact to the Publisher, with the name of the Agent through whom the paper is obtained. Such inconvenience, if suffered, can be remedied by obtaining the paper direct from this office.*

*** *For Subscription Rates, see page 2 of Advertisements.*

*** *All letters intended for insertion in* THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

*** *No undertaking can be given to return drawings or manuscripts; correspondents are therefore requested to keep copies.*

CHANGES OF ADDRESS

*** *Will Subscribers please note that in all advices regarding changes of address it is necessary to have both old and new address, as our lists are kept alphabetically by towns. Advices of this nature should reach us by the first post Wednesday morning prior to the alteration.*

Postal Address: "The Engineer," 28, Essex Street, Strand, London, W.C.2.

Telegraphic Address: "Engineer Newspaper, Estrand, London." Telephone: CENtral 3565 (10 lines).

JET-PROPELLED AIRCRAFT

THE Prime Minister has revealed to us his opinion, and that of his advisers no doubt, on the relative technical equipment of the Fighting Forces of the United Nations and of their common enemy. His frank forceful statement has been received with great satisfaction; it is good to know, for instance, that the R.A.F. is at present maintaining in action throughout the war scene in all its theatres nearly 50 per cent. more first-line aircraft than Germany, and that the ever-broadening supply of new aircraft being received by the British and American Air Forces exceeds the corresponding German supply by more than four to one. As the result of four years' war experience it is realised that victory requires the combined effort of all three Fighting Services acting in unison. Hence, if predominance is achieved in each arm separately our goal is sure. As to the Allied Armies, we have the combined strengths of the Russian and Anglo-American forces with increasingly useful contingents from France and other Allies, and these, in combination make a favourable comparison with all that the enemy can now muster. At sea the position is even more favourable, provided we can keep the U-boat warfare as little effective as it has been for most of 1943. In the air our position grows more and more unchallengeable. This strength in all three Services is deeply impressive and one is almost tempted to believe that the future course of the war should be predictable. And so, "barring accidents," perhaps it is. But that is a large proviso. The great unknown is the conceivable emergence even at this late stage of some new weapon of which warfare to-day has had no experience. That is Germany's one hope of escaping final and crushing defeat. It will be asked whether it is likely after four years' exhaustive inquiry by engineers, inventors, and scientists that anything of overwhelming potency could possibly turn up, especially from the camp of the enemy, where scientific work has for years been gravely handicapped by enforcing large injections of Nazi philosophy to be taken with all scientific instruction and education. It may further be asked whether, even if anything of the kind could now arise, the enemy with his increasing supply difficulties would be able to provide it in time and on an adequate scale. Time will show. We know, for instance, that Germany has for years been interested in rocket and other jet propulsion schemes; and an experiment in this direction is revealed in the new German radio-controlled rocket-glider bomb, which has lately been launched from aircraft against ship targets and bomber formations. This in itself has little novelty; in fact, Patent Offices all over the world have been inundated by such proposals. They are not easy schemes to apply, for the new weapon must not merely be ingeniously contrived, but has to be capable of high accuracy against a target which very naturally can be counted upon to take obvious countervailing measures. No doubt the use of rocket propulsion against ships is intended to give the bomb adequate range and improved penetration should it find its mark. Radio control is bound to be a weakness, since any valuable target is easily provided with radio jamming equipment, and may even have radio technicians skilled enough to take control of the bomb and steer it clear of its target. The parent aircraft, which has to be within a few miles, is also easy prey for any defending fighters.

It had long been known that the enemy was experimenting with jet propulsion. Both the Junkers and Heinkel firms have been at work in this direction, whilst one Italian firm was, for some strange reason, allowed to publish information with illustrations of a flight by such an aircraft as late as August, 1940. The speed and probable range of this craft were, it is true, somewhat elementary, and so far we have heard nothing more of it. As it happens, the whole of the thrust from the engine in an aircraft of this size could theoretically be provided, if one alone of its many cylinders could be pointed aft with its end open, and have maintained in it somehow and in some way a pressure of but a few atmospheres; and even in the normal aero-engine a substantial addition can be made to the engine power by rearward pointing exhaust jets. It is only one step further to design the engine so that these jets make a major contribution. The next natural step—taken by the Italians apparently—is to burn fuel, not only in the engine, but in air which such an engine can be employed to compress; in this way one can get two sources of hot high-speed jets. Judging, however, from Patent Office records, the opinion in most countries favours something simpler; preference is given to the compression of the air in an axial or radial rotor, its admixture with suitable fuel in a combustion chamber, and expansion through a turbine to provide the power for driving the compressor, and finally aft to the power jets. It is not hard to design such a device to work as a toy, but very far from easy to plan it so that it will be economical in fuel and able at the same time to give adequate power at low levels. At great elevations the jet is naturally more productive, as the back pressure is less, and in the stratosphere itself such prime movers are at their best, though they can hardly ask for separate power plants to get them there; they must somehow be designed so that they will operate efficiently at all levels, and that is not easy. But, fascinating as the problem is, it cannot be openly discussed till the war is over. When that day comes it will be realised that our own technicians and those of our Allies have been well to the fore in their investigations of the degree to which a useful weapon of war can thus be produced. We do not think, however, that the enemy will find in this direction the "new weapon" to aid him in his dire need—nor, as a matter of fact, do we think that he will find it in any other direction. He will almost surely have to fight with what he has, alert though we on our part must be for attempted "surprises" and instant with our prepared replies.

Unfounded Assertions

WE all make unfounded assertions. We make them in good faith, honestly believing them to be true. We are hurt if we are asked to give our reasons and defend ourselves with such phrases as "Everybody knows" and "It is common knowledge." We have heard a child told to leave the window open at the top during a thunderstorm so that the lightning could get out of the room again if it got in. No doubt the instructor had been so informed in his youth and passed on his knowledge, honestly believing it to be sound. Even at this day hundreds of thousands of housewives draw the blinds to prevent the sun putting out the fire. Those whose memory goes back to the end of the last century will recall the outcry against Roentgen rays, how they were condemned as grossly indelicate, how a London shop advertised X-ray-proof underwear, and how the American legislature was asked to pass a law against the manufacture and use of X-ray opera glasses! Such folly could never have been had the Press of the day taken the trouble to ascertain the nature of X-rays before it asserted that clothing would no longer protect our decency. Those are glaring examples, but they are not untypical. And it must not be supposed that the ill-taught are

the only offenders. Over and over again false statements are repeated from text-book to text-book. They are accepted on the authority of an earlier author without confirmation by independent inquiry. Many of our readers will recall Mr. Ackermann's attractive book on "Popular Fallacies." Could all engineers put their hands on their hearts and swear that they themselves had never, never, fallen into the errors which the author exposes ?

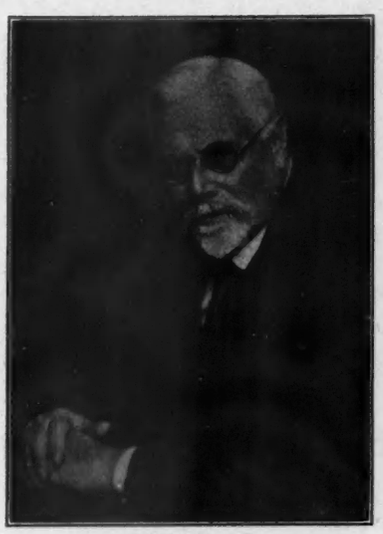
Perhaps one of the commonest origins of unfounded assertions takes the form "It might be so." From that it is but a short step to "Therefore it is so." In his "History of the English People" Halévy remarks somewhere that if all the laws of this land had always been enforced the conditions of the people would have been pitiable. As a matter of fact, they were often tempered or wholly neglected, so that their potency for harm was never exercised on a large scale. But novelists and orators have not always been as careful as Halévy and have based assertions on the existence of the laws rather than on their actual application. Another very common error which leads to immeasurable harm is the projection of the past into the present. People read accounts of the conditions in the mines and factories a century ago and allow the rancour which they arouse to embitter them against the mineowners and works managers of to-day. They do not trouble to inform themselves on the changes that have taken place. Within recent weeks a prominent writer of the Left has described conditions in coal mines that may have existed a few score years ago, but certainly do not exist to-day. But coal mining has always been the happy hunting ground of unfounded assertions. That is no doubt because a psychological factor intrudes. To people who have the slightest tendency towards claustrophobia—people who are ill at ease even in a tube railway—working deep underground is associated with detestable conditions. They picture it as exceedingly dangerous and unhealthy, and obnoxious in every respect. If all Members of Parliament were required to make a personal inspection of a few coal mines fewer errors about them would be heard in debate. Another cause of unfounded assertions arises from false deductions from external effects. Some years ago a gentleman in a civic position described publicly a foundry in a famous works in terms which would have fitted Gehenna. He founded his criticism solely on the fumes that escaped from the louvres and the glare of the furnaces at night. He had never been inside the foundry in his life !

One danger of unfounded assertions is that they may be used to create prejudices which it is very difficult to eradicate. The demagogue and street corner orator revels in them. On the principle that any stone is good enough to throw at a dog, he does not, like David, select his pebbles, but throws anything and everything he can lay his hands on. Another danger is that they may misrepresent or misuse science. In this the daily Press is a frequent sinner. It allows to be printed, not alone in its advertising columns, statements which are contrary to fact. If it would take as much care to verify its assertions as it does—we hope—its quotations, it would less often mislead the public and make itself a laughing stock to the rightly informed.

Obituary

GEORGE LEONARD ADDENBROOKE

By the death of Mr. George Leonard Addenbrooke, of 35, Holland Villas Road, Kensington, London, W.14, which occurred at Chalfont St. Giles on Tuesday, October 12th, a further link has been severed with the early development of electric power and lighting in this country. Addenbrooke, who was in his eighty-fourth year, came of a family of ironmasters. He received his early education at Winchester School, after which he matriculated at London University. His first business position was in the office of the London agents of the British India Steam Navigation Company, Ltd. For four years he studied the mercantile business, but on the strong advice of his friend, Sir Edwin Dawes, decided to adopt engineering as a career, and shortly



George Leonard Addenbrooke

afterwards joined the staff of the United Telephone Company. For about one year he was engaged on overhead wiring work, after which he was appointed to the estimating department and given charge of that work. Advancement continued, and for two years he held the office of chief of the testing and trunk line department, gaining wide experience of cable testing and experimental work. In 1885, in conjunction with Mr. Ferranti, he was granted a patent for a new method of working double-trunk lines in connection with single subscriber's lines, which the company used on a large scale. The year following he joined Mr. Ferranti at the Grosvenor Gallery power station, where he was given charge of the overhead lines and the customers' installations. In addition, he gave considerable assistance in the engine-room and with the general running of the plant. In 1887 he severed his connection with Ferranti and set up a practice as consulting engineer in London. Some time in 1888 he went to Australia for Messrs. Gray, Dawes and Co., where he took charge of the installation of electric light in seven large coasting steamers. When that work was accomplished he paid a visit to the Australian goldfields, and to some of the leading towns, and reported on the possible applications of electric lighting and power. On the return journey he visited Spain on behalf of Crompton and Co., and after a few months' connection with the House-to-House Company, resumed practice on his own account. This work, with the exception of a short time with the Electric Construction Company, Ltd., during its change of management, occupied his attention until the last.

Addenbrooke was the originator of the scheme for the supply of electric light and power to the Black Country, which later became known as the Midland Electric Corporation for Power Distribution, Ltd., and was engineer to the promotors of that scheme. He was also connected with the power distribution schemes for Warwickshire, Shropshire, Staffordshire, and Kent. A man of the widest interests, he was one of a small band of enthusiasts which was formed to investigate the possibility of generating electricity by tidal power, particularly in connection with the River Severn. That work was well done, and when evidence was given on the scheme at a later date, much of the original work of Addenbrooke and his friends was incorporated in the report on the Severn barrage scheme. Apart from his consulting work, he spent much time in his own private laboratory, giving attention to the measurement of alternating currents. He worked out a complete set of instruments and a special system, which he described in a paper on "The Accurate Measurement of Alternating and Multi-phase Currents," delivered before the International Congress of Electrical Engineers, held in Paris in 1900. The set of instruments and apparatus was exhibited, and evoked considerable interest. In recent years he was engaged on the investigation of the nature of solid insulation and the determination of the electrical losses which take place.

Addenbrooke was an early and valued member of the Institution of Electrical Engineers, before which he read papers and frequently took part in discussions. For seven years he was on the Council of the Royal Photographic Society, and he was also a Fellow of the Physical Society, to whose "Proceedings" he frequently contributed.

He will always be remembered amongst the survivors of that dwindling band of pioneers who devoted their lives to the problems of electricity transmission as a man of exceptional ability and perseverance. He was of a retiring disposition, and was in consequence only well known by those who counted him amongst their valued friends. Had he been differently constituted, he would have made a greater mark in the world and the value of the work he did would have been more justly valued.

ENG. COM. W. P. SILLINCE, R.N. (Ret.)

Those who were connected with the early days of the oil engine and its application to naval services will learn with deep regret of the death, on Thursday of last week, October 14th, at 31, Ashen Grove, London, S.W.19, of Engineer Commander W. P. Sillince, R.N. Owing to continued ill-health over many years, Sillince had resigned the membership of the various scientific and technical institutions, and during the past twelve years or so was inactive. There is no doubt, however, that he rendered important services to his country in connection with the burning of oil fuel under boilers, and the application of the oil engine for auxiliary generating plant and for propulsion in naval vessels.

William Patrick Sillince was born in Portsmouth on April 27th, 1876. In 1891 he entered Portsmouth Royal Dockyard as a fitter apprentice. Four years later he headed the list of apprentice candidates for Keyham College, and the following year gained the Newman Memorial Prize. He passed to the Royal Naval College, Greenwich, where he had

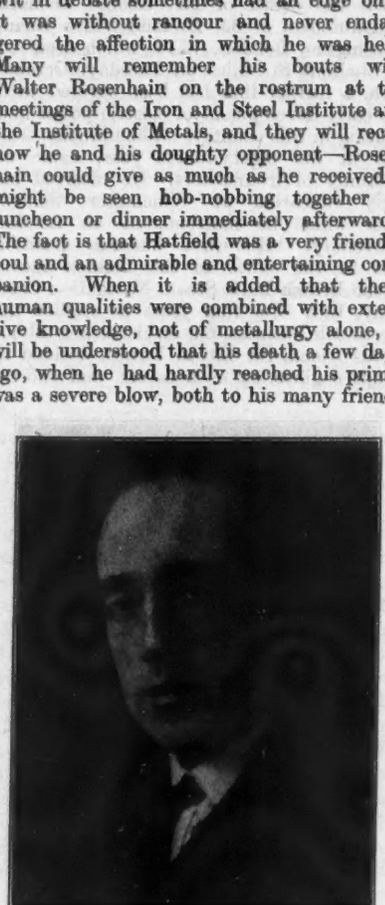
a distinguished career, gaining first-class certificates and prizes in all years. About 1899 he saw service at sea, after which he was posted to the Admiralty on the staff of the Engineer-in-Chief. As an instructor at Greenwich College, he had to do with matters largely connected with the use of oil fuel and internal combustion engines aboard ship and on shore stations. In that capacity he visited the works of Mirrlees, Watson and Co., Ltd., in Glasgow, on Admiralty business at the time the first oil engine driven generating sets were going through the shops for the battleship "Dreadnought" and her sisters of that class, and the cruisers "Minotaur" and "Shannon," and also various engines for motor-boats for pinnace and harbour work. He resigned his commission and joined the staff of Mirrlees, Bickerton and Day, Ltd., in Glasgow, when it was formed in 1908, and moved to the new works at Hazel Grove, near Stockport, in August of that year. At Hazel Grove he was joint assistant engineering manager with Mr. George Windeler, under Mr. Charles Day, Mr. Windeler having charge of the design and erection work and Sillince of the machine shops.

In 1911 he accepted an appointment as director of John Samuel White and Co., Ltd., at East Cowes, in the Isle of Wight, where he had charge of the development of the White-M.A.N. two-stroke cycle valve scavenging oil engine. Several sizes of this engine were built, including those of about 750 S.H.P., which were installed in the monitor H.M.S. "Marshal Ney." In July, 1914, Sillince was recalled to the Admiralty and was posted to Barrow-in-Furness, where he acted as Assistant Inspector of Gun Mountings. In October of the same year he was released by the Admiralty to take charge of the famous destroyers "Faulkner" and "Broke," which were at that time under construction at East Cowes. Before the end of the war, in 1917, Sillince again left John Samuel White's and sailed, as Engineer Lieutenant-Commander, in the mine-layer H.M.S. "Intrepid." That ship was detailed for intricate and special work in the White Sea, which was successfully accomplished. During the period between 1905 and 1917 Sillince lectured and wrote frequently. He was a member of the Institution of Naval Architects, the Institute of Marine Engineers, the Institute of Metals, and the Society of Motor Manufacturers and Traders, which he served on the Marine Committee. He early saw the need for closer collaboration in the marine oil engine industry, and was sponsor of the idea of a British Marine Oil Engine Manufacturers' Association.

After he left the Navy and between long periods of illness, Sillince served two other oil engine building firms, Petters, Ltd., and Peter Brotherhood, Ltd., but his health failed him and he did little connected work after about 1930. For some time he was British representative for the Scoville Manufacturing Company of America, and for short periods he held positions with the B.T.H. Company at Coventry, W. H. Dorman and Co., Ltd., and Filma Burners, Ltd. Those who had the pleasure of working with Sillince will remember his fundamental knowledge of engineering problems and his keenness in solving them.

DR. W. H. HATFIELD

William Hatfield was numbered amongst the best known of the younger generation of metallurgists. He read endless papers, delighted in public discussions, sat on no end of committees, attended to the advertising business of Brown-Firth, delivered lectures galore, and yet found time to direct the joint laboratory of the two firms and to pursue routine and original research. Blessed with a very versatile mind, he could talk, and talk well, on a hundred subjects. If his wit in debate sometimes had an edge on it it was without rancour and never endangered the affection in which he was held. Many will remember his bouts with Walter Rosenhain on the rostrum at the meetings of the Iron and Steel Institute and the Institute of Metals, and they will recall how he and his doughty opponent—Rosenhain could give as much as he received—might be seen hob-nobbing together at luncheon or dinner immediately afterwards. The fact is that Hatfield was a very friendly soul and an admirable and entertaining companion. When it is added that these human qualities were combined with extensive knowledge, not of metallurgy alone, it will be understood that his death a few days ago, when he had hardly reached his prime, was a severe blow, both to his many friends



Dr. Hatfield

and to a profession for which he had done incalculable service.

Dr. Hatfield died after a short illness at Briarcliffe House, Sheffield, on Sunday, October 17th, a few hours before he should have broadcast to Great Britain and America the story of Sheffield steel workers in the B.B.C. "Transatlantic Call" series of talks. The previous day his Presidential Address to the Sheffield Society of Engineers and Metallurgists had to be cancelled because of his illness, which was certainly due in part to breakdown. Up to the last he was busily employed in his many duties as director of research at Thos. Firth and John Brown, Ltd., and director of Vickers-Firth Stainless Steel Company, Ltd.

Dr. Hatfield was born in Sheffield and received his early education in that city at the Sheffield University College, and the Sheffield University. He began his industrial career in the laboratory of Sir Henry Bessemer and Co., Ltd., and received his metallurgical training under Professor Arnold. Later he became metallurgist at J. Crowley and Co., Ltd., Meadowhall Ironworks, Wincobank, and after two years was made director and manager of the firm. Whilst in that position he collaborated with Professor McWilliam on a study of the physical chemistry of the open-hearth acid process, which was presented as a paper to the Iron and Steel Institute. As a Carnegie Scholar, he studied the influence of carbon on the properties of cast iron. In 1916 he joined the Brown-Firth research laboratories and advised the two firms which were in 1930 merged. In these laboratories, which he built up to their present important position, he did important research work on the development of rustless acid-resisting, and heat-resisting steels, demonstrating the qualities of certain austenitic chromium-nickel steels, and producing stainless steels for the Royal Air Force. In 1917 he presented to the Iron and Steel Institute the report on the "Present Position of the Malleable Castings Industry in this Country." He was a valued Vice-President of the Iron and Steel Institute and rendered services of singular value by the formation of the Committee on the Heterogeneity of Steel Ingots, which in 1928 was followed by the Corrosion Committee. He was also a member of the Iron and Steel Research Council. In 1928 he went to America as Campbell Memorial Lecturer at Philadelphia. During his career he was the recipient of many honours, these including the Mappin Medal in 1902, the Crompton Medal of the Institution of Automobile Engineers in 1929, and the Bessemer Gold Medal of the Iron and Steel Institute in 1933. He was a Fellow of the Institution of Chemical Engineering, the Chemical Society, and the Institute of Patentees, and in 1935 he was elected a Fellow of the Royal Society. He found time to give many lectures and papers before scientific societies and technical institutions. They included the Royal Society, the Royal Institution, and the Institutions of Mechanical Engineers and Automobile Engineers, and the Royal Aeronautical Society. He was a member of the Executive Committee of the National Physical Laboratory and the Metallurgy Board of the Department of Scientific and Industrial Research. When the Steel Control was formed by the Ministry of Supply, Dr. Hatfield was made Chairman of the Technical Advisory Committee of the Special and Alloy Steels Committee. Alongside his many papers we may recall his standard text-books on "Cast Iron in the Light of Recent Research" and "The Application of Science in the Steel Industry."

Works Exhibition

With the object of familiarising individual employees with the activities and wartime products of fellow-workers in each section of the works, David Brown Tractors, Ltd., recently staged a comprehensive two weeks' industrial exhibition in its assembly hall, with the co-operation of the Directorate of Public Relations, Ministry of Supply. The objective was taken a step further by exhibiting products of associated David Brown companies. After four years of almost continuous long shifts, it was realised that families were beginning to miss the company of their workers, and the families were therefore also invited to look round the exhibition. It was felt that this action would convince them of the necessity for a continued drive for increased production and create a feeling of personal pride in the part which the company is playing in the national effort. Added interest in the exhibition was provided by the attendance of Service speakers direct from the battle fronts, who talked to the workers on their experiences.

The Institute of Refrigeration.—It was decided at the forty-fourth annual meeting of the British Association of Refrigeration to include in its constitution a qualified class of technical membership, attainable by examination on the lines of the major engineering institutions. At the same time, this society has renamed itself the Institute of Refrigeration, the change in name and constitution to take place on March 26th, 1944. The President of the B.A.R., Dr. S. F. Dorey, and the Executive Council are now engaged in the foundational arrangements.

Engineers and the British Empire

By Professor MIDDLETON SMITH, M.Sc., M.I. Mech. E., LL.D.

No. XVI—*(Continued from page 300, October 15th)*

NEW ZEALAND

NEW ZEALAND has a population of about 1½ millions, of whom the Maoris number under 65,000. Really effective settlement dates from 1840, although there were traders from 1792 onwards, who were often lawless in their activities, causing conflicts with the Maoris in the early days.

As often has happened, the British Government at first seemed to be unwilling to take over any responsibility for these islands, situated so distant from England. Dr. J. B. Condliffe, research secretary, Institute of Pacific Relations, tells us that recent historical research "has provided a reasonably clear picture of the tangled relations between the New Zealand Company, the missionary societies, and the Colonial Office in England, and their representatives, the Governor, the missionaries, and the settlers in New Zealand during the first ten years of settlement." He adds: "There can be no better illustration of the traditional muddle out of which the Empire has grown." The people of New Zealand became, when law and order was established, amongst the most loyal subjects of the Crown. They have made rapid progress in the development of a country very suitable for colonisation, for it possesses a fine climate and most productive soil, but with a mountainous land that has made communications difficult, but useful for water power production. It is one of the triumphs of the Empire that to-day the Maoris take an active part in legislation and other public services, and in the defence of the Empire, in spite of their small numbers.

A remarkable pioneer, named Wakefield, devoted himself to the public service of urging colonisation in New Zealand in the 1830s onwards. He informed a Select Committee of the House of Commons (London) that "we are, I think, going to colonise New Zealand, though we be doing so in a most slovenly and scrambling and disgraceful manner." In due course the colonists made good progress, in spite of the insular character of their territory, their enormous distance from anywhere, and, in the early days especially, their complete isolation.

The pioneer settlers were not only isolated from all other lands, but almost equally from each other. The country is not only mountainous, but covered with dense forests, with almost insuperable obstacles to transport. Isolation was inevitable until roads and railways were built. It was, at first, difficult to obtain sufficient capital to carry out these works. Although the area of New Zealand is roughly equivalent to that of the British Isles, the population is only 1½ millions, as compared with our 46 millions.

The Dominion has attained a reputation for experimental legislation, and particularly for measures of social welfare. But, in spite of an idea that Socialism flourishes, State economics have been confined to public operation of utility services. Experiments in municipal trading are jealously watched, but the provision of public utilities is accepted as a proper municipal function.

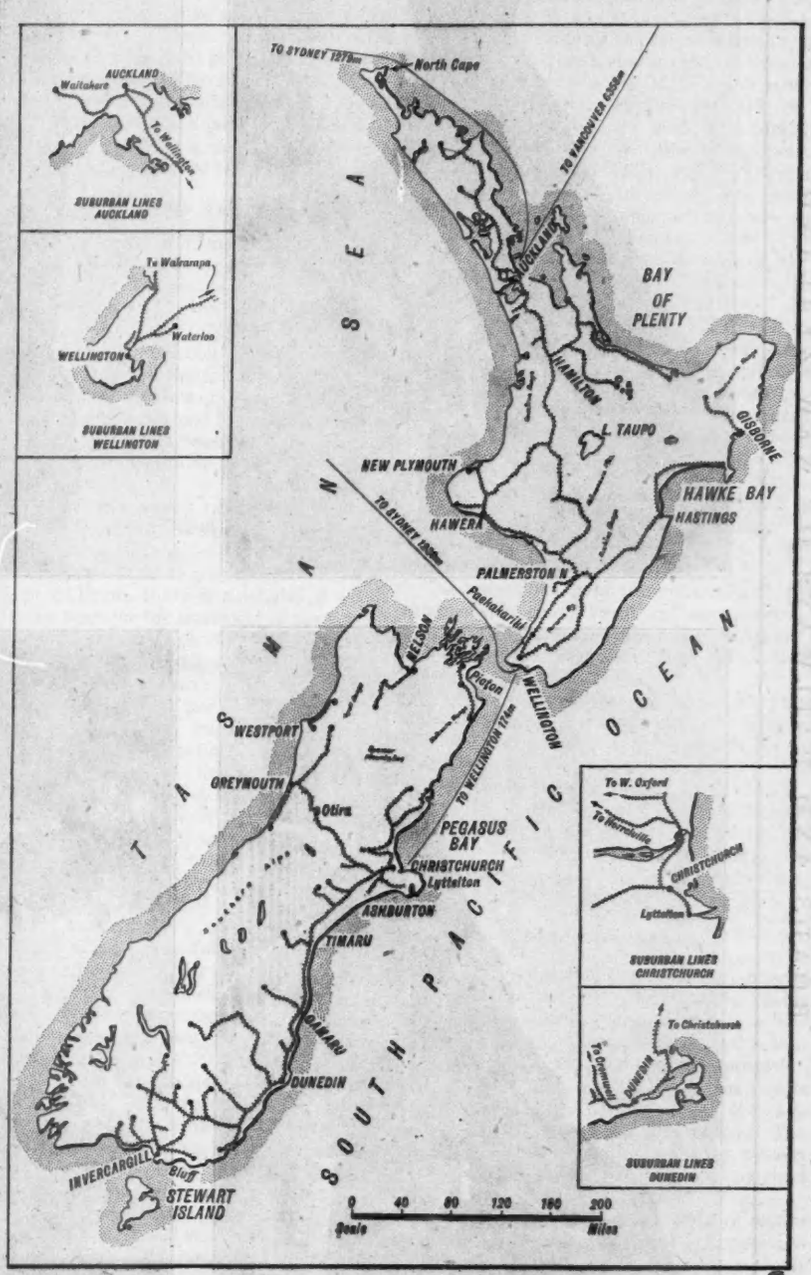
GOVERNMENT ENGINEERS

The active construction of public works and railways dates from 1870, when a policy of State borrowing for immigration and public works was initiated. It was done for practical, rather than for theoretical, reasons. Railway history dates from 1860 when the contract was made for the construction of a line from Christchurch to Lyttelton. In 1876 the railways passed from the control of Provincial Governments to a Public Works Department.

It is notable that of the public servants the greatest number are employed on railways; next come posts and telegraphs; then education, with administrative departments and public works following in that order. The number of public servants is estimated at about 10 per cent. of the total population.

The public works that were essential for opening up a new and difficult engineering country have been extensive, and the policy has been to employ Government engineers rather than contractors, which has helped to swell the ranks of public servants. These various functions of Government were in use before 1890, and were almost inevitable, because of the Colony's isolation and lack of financial organisation.

A State Coal Mines Department was established in 1901. State departments and municipalities do not encroach upon capitalist organisations, except in the case of public utilities. Planning of surveys, railway development, hydro-electric supply, and public works in general has been done most efficiently. The men who planned the groundwork of New Zealand development were able and conscientious public servants, and that tradition has been carried on by New Zealand-born engineers and scientists.



NEW ZEALAND AND ITS RAILWAYS

ROADS AND RAILWAYS OF NEW ZEALAND

MANAWATU GORGE, NORTH ISLAND

NAPIER-TAUPO ROAD, NORTH ISLAND

JOHNSONVILLE RAILWAY, WELLINGTON, UNDER CONSTRUCTION

TE ANAU-MILFORD SOUND HIGHWAY, SOUTH ISLAND

cultural products of the country, especially meat. This gave a great impetus to cattle raising. Dense forests were converted to pastures and 20 million acres of grasslands, of good quality, were gained for farmers. To-day it is claimed that New Zealand has the largest overseas trade per head of any country in the world, together with a very high standard of economic welfare. That has been largely due to the successful transport, half-way round the world, of frozen meat and chilled dairy products. Difficult engineering problems were solved when railways and roads over mountains were built, in order to aid the farmers. It can be said that the whole of the development of the Dominion has been influenced by its isolation, its forests, and its mountains; economic development has radiated mostly from the ports.

Water power is utilised. It is fairly well distributed over both islands, and as it is developed will become a more and more valuable manufacturing asset, which will compensate to some extent for high cost of production and transport of coal. Isolation and a small local market, together with the decentralisation inevitable by the geography of the country, has hampered manufacturing progress. It is in many cases cheaper to import goods from overseas than to move them from one place to another in New Zealand. A factor of importance has been the speeding up of sea transport, which has favoured export industries and at the same time intensified overseas competition with local manufacturing industries. An important phase of the immigration policy was the encouragement of skilled labour to aid industrial development. Bounties and tariffs were used also. In 1939–40 some 108,722 persons were employed in factories, earning about £24·5 million per annum.

Direct and regular steamer communication was opened up with England in the 1870s. Previously, most of the trade went through Sydney. The gold rush in Australia assisted New Zealand farming industries, but the discovery of gold (1857) in New Zealand was not an unmixed blessing. Few of the prospectors profited by their work, and many perished, but the survivors benefited the country by providing sturdy immigrants and additional capital. It is notable that the population increased from about 99,000 in 1861 to 248,000 in 1870.

In the early days the economic development of the South Island was more rapid than that of the North Island, but in the last fifty years the great transformation has been mainly in the latter island. It is estimated that 25 per cent. of the population are living in the four main cities, and a further 14 per cent. in twelve towns, with a population of between 10,000 and 25,000; others are in smaller towns. There are four main ports, together with six other ports, exporting well over a million pounds worth of produce in normal years. There has been a criticism that some of the smaller ports have overcapitalised their harbour construction works, but that is probably justified, for it is planning for the future.

The principal sources of wealth of the country are the sheep-raising industry and the dairying industry, the latter, together with the meat industry, being dependent upon the progress in refrigeration. Water power for the generation and supply of electricity, is a great asset. Although the farmer has to send his products half-way round the world to his chief market, the dairyman in New Zealand obtains about 81 per cent. of the wholesale price for his butter in London and about 70 per cent. for his cheese. It is worth mentioning that the Winsconsin farmers, ten times nearer their market, obtain smaller proportions for the wholesale price of their produce. To-day the dairy farmers are the biggest single group at work in the Dominion, except for the various types of civil servants.

Rather more than 25 per cent. of the population are engaged in primary production, about 24 per cent. in industrial work, and nearly 11 per cent. in transport and communications. In recent years secondary manufacturing industries have increased more rapidly than the primary occupations, but not as fast as governmental or commercial services. Of these secondary industries, meat freezing heads the list, and chilled butter comes next.

There is a great range of demands in engineering, printing, and similar industries, which are met by local production to a considerable extent. The agricultural implement industry is important, and in recent years branch establishments, such as large factories for assembling motor vehicles, have been established in order to save freight.

Mechanised Transport

The Dominion is 1000 miles in length. The first railway line was opened from Christchurch in 1863, and soon afterwards a tunnel was put through the port hills to Lyttelton. In the four years from 1873 to 1877, some 907 miles of railway were completed, and during the next twenty years another 1117 miles were added. This was slow progress, because of the difficulty experienced by the Government in borrowing the necessary funds, possibly owing to the unprofitable nature of the lines already built.

In 1891 Government railways opened for traffic totalled 1842 miles; in 1911 the length was 2753 miles. There are private lines whose chief object is to serve collieries or sawmills, and, in addition, there is a length of about 180 miles open for the transport of passengers or goods. There are now 3300 track miles of railway, which approximates to the Great Western Railway system in Britain. Sleepers are laid down 2500 per mile; they are principally Australian hardwood and New Zealand silver pine or totara.

A main trunk line in the North Island was completed in 1908, and other lines, constructed by private enterprise, were incorporated in the main trunk system in that year. In this island the total mileage is 1634. The main trunk line is from Auckland to Wellington, and is 425½ miles long. There are thirty-two tunnels; one is 3515ft. long and eight are more than 1000ft. in length. In 30 miles the train climbs 2160ft.

The length of the South Island system is 1756 miles. New construction work on this island main trunk railway (divided into two sections, one 48 miles 70 chains long, the other 29 miles 40 chains) had made good progress (1939). It involved heavy protective works on account of the nature of a great deal of the coast line along which the railway runs. On another line construction was delayed for a time by a very heavy rainfall of 211·5in. for the year.

The Lyttelton tunnel was opened in 1867; it goes under the narrowest part of the range, where it is nearly 1000ft. high and its length is 2680 yards. Making the tunnel was an enormous work for a settlement less than twenty years old. It cost £195,000, a big sum for the then small population of the Canterbury Provincial Government to raise. The provincial engineer and chief surveyor, Mr. Edward Dobson, did splendid work. The line from Christchurch crosses the Canterbury Plain, 100 miles long and about 45 miles wide, transformed by man from a wilderness into a golden land, now a great granary and sheep country. Every now and again a branch line goes inland to form a profitable feeder for the main railway. A bridge over the Rakaia River is 1¼ miles in length. Of the fifteen principal bridges of about 500ft. or longer on this line, nine exceed 1000ft. in length.

Some day, when all along a 600-mile route from Picton to the southern end of the island the rivers are bridged, the ridges are tunnelled and the mountain sides cut, the express train will take the traveller down through beautiful country. At present the railway covers the 230 miles from Christchurch to Dunedin, and on to the southland's seaport, the Bluff, another 156 miles.

The Government railways are constructed by the Public Works Department, and transferred to the Railway Department when completed. Steam and electric locomotives are in use. In 1940 some 1236 wagons were built and construction was in hand for a number of engines, cars, vans, and wagons. In 1939 the value of railway equipment imported was £1,383,994 and equipment for road transport imported was worth £5,595,957. The number of persons employed on State Railways in 1941 was 24,502, of whom 6267 were in workshops.

Since 1924 the consulting engineer to the New Zealand Government has been Mr. Roland J. Harvey, M. Inst. C.E.

The use of electric power for railways is increasing to a great extent for many purposes, and there are twenty-three sub-stations having a total capacity of 14,300 kW. The Christchurch and Lyttelton section of the railway, including the Lyttelton tunnel, was electrified in 1928–29; the Otira and Arthur Pass section, including the Otira tunnel, in 1923; the Wellington and Johnsonville section in 1938; and the Wellington and Packakariki section in 1940.

The numerous mountain chains and the innumerable rivers made railway construction both difficult and expensive. Engineers triumphed over the difficulties and unusual problems caused by Nature.

The Raumisa spiral, in which the line climbs 714ft. in a complete spiral distance of 5 miles through several tunnels, is an example. The Otira tunnel, which pierces the Southern Alps at a height of 2435ft., is seventh on the list of the world's longest tunnels and the longest—5¼ miles—in the British Empire. The Rimutaka incline, on a 1 in 15 gradient, has operated for many years with the "Fell" system of centre rail.

Road Construction

The road system includes important arterial routes which include concentrated traffic from feeder and settlement roads. The increasing density of traffic, involved reconditioning the highway system, the provision of footpaths, and, where possible, cycle tracks, and lighting. Many dangerous railway crossings have been eliminated. The maintenance of the main highways system (1939) cost £119·9 per mile. At times flood damage has been extraordinary.

The great increase in the growth of motor traffic in recent years has made it imperative to maintain State highways to a high standard. It was found to be impossible to keep up macadam surfaces in anything like a reasonable condition. A paved surface has been provided. That entailed reconstruction of foundations and the careful preparation of the road surface to obtain the required shape. The extremely wet or dry periods, as well as heavy traffic, caused rapid deterioration of macadam surfaces. It has been found that highway sealing has made a definite contribution to the safety of roads. Visibility and comfort have been increased through the

removal of the dust nuisance. Considerable assistance is given from the State highway funds towards the construction of paved footways, especially in closely settled areas, to increase the safety of pedestrians. The length of dustless surfaced highways in March, 1939, totalled 2800 miles. In the year before that date 25,000ft. of new bridging was opened to traffic. The chief structures were :—The Rakia River bridge, 5762ft. long ; the Whirokina viaduct, 3600ft. long ; and the North Rangitata bridge, 2122ft. long.

Extensions and improvements for roads and railways involve surveys, ballasting, excavations, tunnelling, new bridges, accommodation for workmen, &c. Disastrous floods create considerable repairs. In 1940 there were 53,086 miles of formed roads, 17,316 miles of unformed legal roads, and 5120 miles of bridle tracks. The total length of bridges incorporated in the road system was (1940) 620,062ft., of which 212,132ft. were built of Australian hardwood, 167,201ft. of native timber, 57,775ft. of steel and timber, the remainder being either mostly steel and concrete, all concrete, or stone. The control of roads and bridges comes under the Public Works Department. In 1941 the total number of motor vehicles licensed was 313,087.

(To be continued)

Inventors and Employers*

From the outset your Committee has naturally been attracted by the doctrine that any inventor should be free to patent or deal with his own inventions as he thinks fit, but has recognised that this needs considerable qualification. In particular many employers are the beneficial owners of certain, at least, of their employees' inventions. Again, inventions affecting the safety of the State may have to be controlled.

It has been thought advisable to obtain some authentic information as to existing conditions respecting inventions and their ownership imposed by various types of public bodies upon their employees or members.

Information was already available in the Institute's offices as to King's Regulations and the Joint Electricity Authority's contract out of which the reference to your Committee immediately arose. Further information was obtained from the Department of Scientific and Industrial Research, the British Medical Association, Cambridge University, Liverpool University, the Post Office, the School of Agriculture, Cambridge, and University College, London.

The information before your Committee showed that there are broadly two forms of invasion of the principle that a man may do what he likes with his own invention. First, the employer may be the beneficial owner of the rights in the invention by the operation of the common law or by contract ; and secondly, a body having no rights in the invention, but able, in one way or another, to exercise control over the inventor's actions, may impose conditions on the patenting, the ownership, or even the use of the invention.

The Department of Scientific and Industrial Research drew attention to a Report published by the Patents Committee of the Civil Service National Whitley Council in 1930. In this Report that Committee discusses the question of inventions made by Government servants and accepts the view, already expressed by a previous Inter-Departmental Committee known as the Lee Committee, that an invention made by a Government research worker is the property of the State, and that in the case of persons not employed specially on research the Government has certain rights in inventions made either in the course of their employment or with the aid of knowledge or facilities gained through such employment. So far as employees of the higher technical grade are concerned, this view appears to be in complete accordance with the common law on the subject of "Master and Servant," as illustrated by the various cases that have come before the Courts. In the view of your Committee, the common law is excellent in its application to such employees. No objection is seen to its extension by contract to employees of any grade or class, but Service agreements that are more restrictive on employees appear to be an abuse of the power of an employer in a world in which the necessity to obtain employment may be paramount. Accordingly there appears little to cavil at in the Lee Committee's general statement about the ownership of inventions made by Government servants. It is in defining the rights that difficulty arises, as the Whitley Council's Committee recognised. Their proposal was that a central body with an independent chairman should be established and should be in effect an Appeal Tribunal from the decision of the Department concerned. They further recommend that any Government servant should be free to file a provisional application, but that, on doing so, should send a copy of the specification to the head of his Department, and that while a decision was being made the rights in the invention should be deemed to belong to and to be held in trust for the Government. With the safeguard of an Appeal Tribunal, this procedure appears to your Committee to be wholly satisfactory.

The Report of the Patents Committee of the Whitley Council has been dwelt upon because it is clear that the State is the largest employer of labour in the land and that any action it takes is likely to be regarded as a precedent by the many semi-public bodies now in existence. We believe that there is a tendency for these bodies and for employers generally to introduce into service agreements clauses that serve to transfer to the employer all inventions, whether in any way arising from the employee's work or not, and this practice appears to be most undesirable. In the view of your Committee, some part of the freedom of the employee should be restored by prohibiting employers from imposing any conditions on the ownership, use, or protection of an invention made by an employee and having no connection with the employee's work for the employer or with matters coming to his attention by reason of his employment. The State in its capacity as employer should (and it is believed, broadly speaking, does) refrain from imposing such conditions in similar circumstances. It is somewhat doubtful whether the above suggested prohibition should be wide enough to prevent anyone from engaging a "professional inventor" to make inventions of any kind on the basis that all the inventions he made would become the employer's property. On the whole, it is believed that employers should be free to engage "professional inventors" on this basis, and it is the intention of your Committee that the suggested prohibition should not be such as to include that specific case.

It will be appreciated that the procedure recommended by the Lee Committee and the Patents Committee of the Whitley Council for Government servants is not applicable generally to other employers because of the practical impossibility of setting up an Appeal Tribunal to which inventors might appeal from the decisions of their employers.

Many suggestions have been made as to methods by which it could be legally provided that an employee should receive an appropriate reward when an invention which belongs to his employer, either by operation of the common law or by contract, proves to be commercially profitable. The opinion has been expressed above that there is nothing objectionable in the view that an invention made by a Government research worker belongs to the Government and that the present common law is excellent in its application to employees of the higher technical grade. The practice of Government Departments when an invention is made by an employee, either in the course of his employment or with the aid of facilities gained through such employment, is exemplified by many agreements by which use for the Crown is reserved, but the inventor is left free to exploit the invention commercially, both at home and abroad, most commonly, in practice by way of agreement or licence approved by the Department concerned. The Department retains a proportion, usually about half, of any purchase price or royalties accruing. Such an arrangement is clearly not generally applicable and it is thought that the difficulty of making any provision that would suit all cases is insuperable. Many enlightened employers already recognise the value to them of inventive ability in an employee, just as they recognise other technical, administrative, or commercial qualities. An inventor has the further advantage that his name appears upon patent specifications, and there is no doubt that a successful invention increases the inventor's potential value to employers in the whole branch of technology concerned. The importance to employers of seeing that successful inventors are suitably recognised and rewarded both during the normal term of a patent and that of any prolongation obtained, whether by freedom to exploit in other countries or in branches of industry or by cash grant, royalty, increase of salary, promotion, or by some other method suited to the particular case, hardly needs to be stressed, but it is mentioned here because it has been kept in mind while coming to the conclusions expressed in this Report.

Interference with inventions that are the inventor's own property appears to be most undesirable and improper, however excellent the motive that prompts it. Existing examples of this are :—

(1) The imposition on its members (not employees) by an association of a prohibition on patenting inventions relating to particular subject matters.

(2) The requirement made by some employers that the employer's consent should be forthcoming before any patent application whatever is made.

Another existing form of interference is :—

(3) The requirement made by the Service Departments that leave shall be obtained before a patent agent can be consulted about any invention or instructed to draft and file even a provisional specification.

It is thought that any such interference should be stopped, subject to two provisos, viz.:—

(1) That the State should have the right to impose secrecy upon an inventor for reason of State, at any stage.

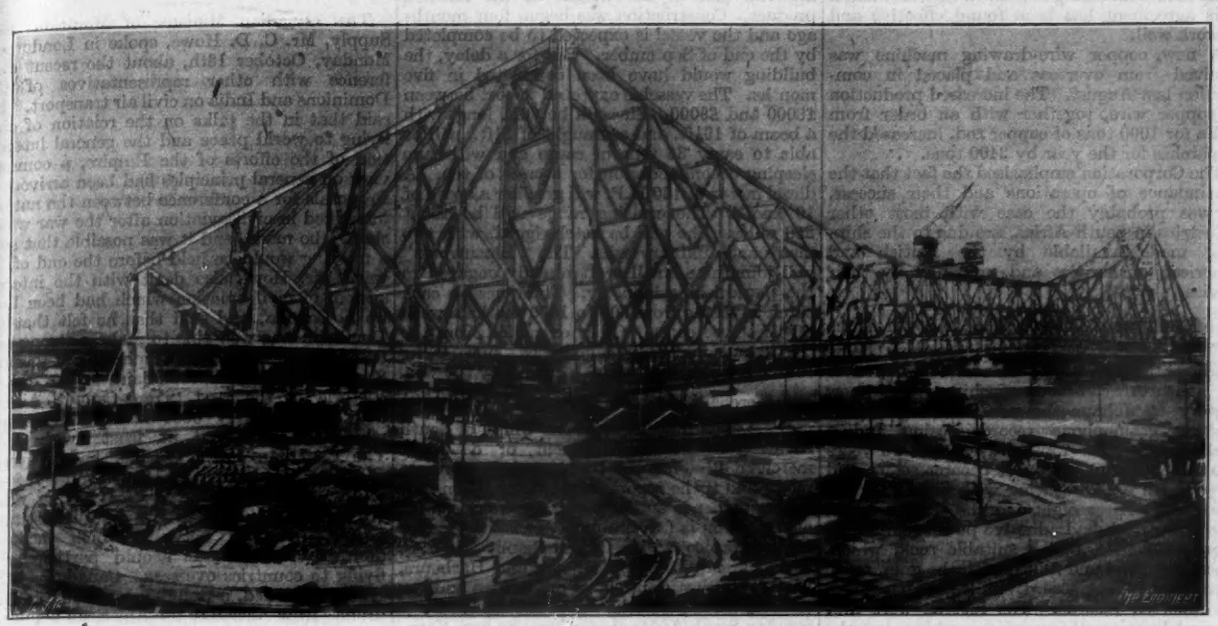
(2) That in the cases of those who deal professionally or in the course of their work as consultants, &c., with the patenting or development of other people's inventions—such, for example, as patent agents and Patent Office Examiners—it must be provided that it is permissible for rules governing the patenting of and dealing with inventions to be imposed upon such persons by their professional associations or other appropriate authority.

So far as the Service Departments are concerned, the requirement set out in paragraph (3) above seems unfair to the inventor, in view of the importance of the filing date and the effect which the wording of a provisional specification can have upon the scope of the protection, both here and abroad. If the Departments do not feel able to abolish the rule entirely, it is suggested that some procedure should be adopted by which individual patent agents might be authorised to receive disclosures of the inventions of Service inventors and act for them in obtaining provisional protection without leave having to be obtained in each case. It is unnecessary to point out here that probably in their profession patent agents are entrusted with as many secrets in the course of normal business as any comparable body of persons and that in any case they work under the control of the Board of Trade.

* Report adopted by the Council of the Chartered Institute of Patent Agents, August, 1943.

Canada's Oilfields.—It is announced that the Dominion Government intends to finance the drilling of ten wells in Turner Valley, at a cost of approximately 2,000,000 dollars, through Wartime Oils, Ltd.

HOWRAH BRIDGE, CALCUTTA



Letters to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents)

"BOONDOGGLING"

SIR,—As to the American word "boondoggling," mentioned in your editorial of August 13th, it refers to unnecessary and trivial work given out ostensibly for relief, but actually for political purposes. The men engaged on it are apt to show their opinion of it as work by consistently loafing on the job. Like many words of this character, it has become practically obsolete already, and it is to be hoped that it will not be revived by new relief measures in post-war periods. E. E. R. T.

Illinois, September 3rd.

"THIS FREEDOM"

SIR,—British manufacturers do not seem as yet to have made up their minds about how they propose, when the war ends, to go about selling to other countries what they make.

It is true that the Board of Trade set up, last year, a Central Committee of Export Groups, although others have suggested that it would be well if the Groups themselves were to begin to fade out of existence when peace arrives. The Association of British Chambers of Commerce advocates a Council of Industry. The Institute of Export and the Federation of British Industries have probably got plans of their own.

Although there is so much diversity in the approach to the problem, the need for an expanding export trade is, naturally, accepted by all. There is an almost equal unanimity that each industry must be left in control of its own affairs, that the flexibility of private enterprise ("a good ship," to quote Sir William Beveridge, "which has brought us thus far") must be reconciled with the rigidities of the planner.

A step out of this confusion about the means to be taken to attain an end universally desired is indicated by the action of the rubber industry, which has now grouped twenty-four distinct associations into one federation of 289 firms with 320 factories. Their common bond is that all of them use the same raw material—for shoes, tyres, belting, gloves, sports goods, garments, and a variety of other products.

The example of this important cross section of British industry might usefully be considered by other trade associations who will have already been impressed by the advantages of working together in wartime.

Let them federate. When they have done so they will hold the key to regulating the flow of trade into those channels which will yield maximum employment to the men as they come home. STRATHSPEY.

Rottingdean, October 15th.

BOILERS OF THE "BISMARCK"

SIR,—With reference to the leading article in your current issue, entitled "Battleship of the Future," it will no doubt be of interest to know that the main boilers in the German battleship "Bismarck" were of the La Mont forced and controlled circulation type.

The working pressure was 55 atmospheres (810 lb. per square inch) and the final steam temperature 450 deg. Cent. (842 deg. Fah.).

R. E. TREVITHICK.

London, S.W.1, October 18th.

Howrah Bridge

THE new Howrah bridge at Calcutta was recently opened to traffic. This great bridge, the third largest cantilever structure in the world, carries a roadway, 71ft. wide, and two footways, 15ft. wide, across the Hooghly River. It has a central span of 1500ft. The roadway, as can be seen from the accompanying engraving, is suspended beneath the main girders of the main span, but does not extend along the anchor arms which stretch out over the land. Approach roads, independent of the anchor arms, turn in under them to reach the bridge deck at the main piers. The cantilever arms are each 468ft. long and carry between them a suspended span 564ft. long. Each anchor arm has a length of 325ft. The engineers to the bridge are Rendel, Palmer and Tritton, of Westminster, and the contractors are the Cleveland Bridge and Engineering Company, Ltd. The superstructure was erected by two travelling cranes designed to creep along the upper booms first of the anchor arms, then of the cantilevers, and finally of the suspended span building out the structure before them. One of these cranes, which was designed by the Wellman Smith Owen Corporation, in conjunction with the main contractors, can be seen in the engraving engaged in dismantling its fellow. Work upon the bridge was begun before the war.

South African Engineering Notes

(By our South African Correspondent)

CAPE TOWN, July 28th.

Union Steel Corporation (of South Africa)

THE annual meeting of the Union Steel Corporation (of South Africa), Ltd., was held in Johannesburg on June 24th. The Corporation may almost be considered as a subsidiary of the South African Iron and Steel Corporation, as the latter company (Iscor) has so large a holding in it. The shortage of suitable scrap iron and steel is continuing to cause anxiety. Iscor, however, generously agreed to continue to forgo its share to which it is entitled under scrap pool agreement. There is no shortage at the moment of higher-grade scrap, for the conversion of which additional plant has been ordered. In the recent past there have been purchases by the Corporation of billets from overseas for re-rolling into sections, but supplies became practically unobtainable during 1942, with the result that the dispatches of open-hearth steel products show a reduction of about 5000 tons. Owing to continued rises in manufacturing costs, it was necessary to apply to the Price Controller for permission to increase the sale prices of steel products, with the result that two increases took place, one from April 1st, 1942, and the other from October 1st, 1942.

The demand for products essential to the gold mining industry showed an appreciable falling-off during the latter part of 1942 as the result of steps taken by the gold mining industry to draw a portion of their requirements from their own stocks. However, the open-hearth furnaces operated at maximum capacity and the reduced demands from the mining industry enabled more of the available steel to be diverted to the manufacture of products for the Director-General of Supplies and for other essential purposes.

Sharing the Steel Products

The manufacture and distribution of steel products are now carried out by agreement

with the Controller of Steel, on the one hand, and manufacturers, merchant stockists, and other main consuming bodies, on the other hand. This agreement has been found effective and to work well.

A new copper wire-drawing machine was received from overseas and placed in commission last August. The increased production of copper wire, together with an order from India for 1000 tons of copper rod, increased the dispatches for the year by 2400 tons.

The Corporation emphasised the fact that the continuance of operations and their success, as was probably the case with most other industries in South Africa, are due to the shipping made available by the British and American authorities and protected by their navies.

Gramophone Records Made in South Africa

Gramophone records are now being made entirely from South African materials by South African-made machinery in a new factory at Johannesburg. The firm started making gramophone records, using Indian shellac, before the war. But about two years ago imported raw materials became scarce and they began experimenting with South African materials. After eight months they found a tree gum which had adhesive powers similar to those of shellac, and a suitable rock, which, when powdered and mixed with the gum, made a very hard tough record, similar in appearance to imported records. The records were first pressed by a small imported machine, but the demand has grown so rapidly that a new factory has been started. About 100,000 of the new records have been made. The potential output of the factory when all the new machinery is working is about 50,000 a month.

More Electricity Being Used

Despite the blockade and the acute scarcity of new domestic electrical equipment, the consumption of electricity in Cape Town has shown a steady increase during the war, and is greater to-day than in any pre-war years. The introduction of the dim-out at the end of last year had the immediate effect of reducing electricity consumption for street lighting from hundreds of thousands to mere thousands of units a month. But the loss in street lighting has been more than compensated by the extra demand for power and light by military camps, harbours, and wartime factories. Although the electric trains and tramways have curtailed their services, the consumption of electricity shows no decline, because trains and trackless trams are now usually loaded to capacity and the current consumed is proportionate to the load carried. Since 1939 electricity consumers of all classes in Cape Town increased from 51,375 to 57,730 in 1942. Electricity consumed by factories has increased from 36 million units in 1940 to 47 million units in 1942. The municipal income from private consumers alone was £925,246 in 1941 and £962,355 in 1942, while the estimate of £964,320 for 1943 will probably be greatly exceeded.

Irrigation of the Karoo

The Minister of Lands, Senator A. M. Conroy, speaking recently at Calvinia, outlined his plans for the irrigation of the North-Western Cape districts. The Karoo, he said, comprised some of South Africa's best farming area, but it needed water. One of the irrigation schemes he had in view would provide a canal linking the Orange River with the Zack River in the Calvinia District. He promised that modern drilling plants would be provided to meet the requirements of farmers in North Cape districts who were dependent on underground water supplies.

Welded South African Vessel

The first all-welded steel craft to be built in South Africa is nearing completion at Kalk Bay Harbour, near Cape Town. It is a 51-ton shark-fishing motor vessel, to be named "Blaauwbok." A Cape Town firm, the Jameson Welding Works, decided to build a number of small craft for shark fishing, and it determined to use this method, not only because it had a staff experienced in the use of welding equipment, but because fewer men would be able to build the vessels quicker, with a saving in material and in the weight of the finished product. Construction was begun four months ago and the vessel is expected to be completed by the end of September. But for a delay, the building would have been completed in five months. The vessel is expected to cost between £8000 and £9000. She will be 60ft. long, with a beam of 19½ft. and a draught of 5½ft., will be able to carry 35 tons of cargo and will have sleeping accommodation for a crew of ten. A diesel motor of 150 H.P. will give her a speed of 10 knots. The cruising range will be about 250 miles. She will be ketch-rigged, with two masts and auxiliary sails. The "Blaauwbok" will join three small craft already engaged in the shark-fishing industry. These vessels each catch anything from 600 to 1000 sharks a week off the Cape coast. Oil is extracted from the livers and fetches a high price, since other sources of supply have been cut off by the war.

Merchant Fleet for South Africa

The movement in the Union of South Africa for the establishment of a Union merchant fleet has the backing of the Government, and if the report of the Commission now taking evidence at the ports and large centres of the Union is favourable, there is little doubt that the project will be taken in hand. Mr. F. C. Sturrock, Minister of Railways and Harbours, is an enthusiastic supporter of the idea and has recently declared that as an independent country South Africa should have its own Navy. Even as it is, an adequate training school is to be established to fit South African youth to supply the few ships that the Government at present possesses. Mr. Sturrock hopes it will be possible next year to introduce a new Merchant Shipping Act, which will enable the Government, not only to train its own sailors, but to qualify them. After that we shall be able to register ships in South Africa, which has not been possible before. Mr. Sturrock declares that the future markets of the Union are to be found in the hinterland of Africa, and we should establish a pan-African sphere in which the Union itself would be the workshop. These outlying markets could only be supplied adequately by ships. Mr. Sturrock says he is quite prepared to provide the ships—ships which might possibly be built in South Africa, manned by South Africans, and filled with South African produce, and supply goods as far north as the Equator and even further.

Dr. J. H. van der Bijl, manager of the Iscor Steel Works and Director-General of War Supplies, and also of Civilian Supplies, has given an assurance that all the materials for building ships can be produced in South Africa, and two experts engaged by the Government have reported that the head of Durban Bay is the most suitable site for a shipbuilding industry. Mr. Sturrock also stated that Britain and the U.S.A. were already discussing the question of civil aviation after the war, and gave an assurance that the Union was taking its full and fair part in those discussions. By the establishment of these civil airways immediately after the war the Union would help to open up much-needed markets. Of course, the Union will also negotiate with other parts of the British Commonwealth for the establishment of long-distance overseas flights.

Dehydration in South Africa

Valuable advice on the dehydration of fruit and vegetables has been given by the Anglo-American Dehydration Mission to the Union Deciduous Fruit Board, which is shortly embarking on the dehydration of pears, apples, and oranges on a large scale. During the past season 7000 tons of pears were sun-dried by the Board, but as dehydration gives better results, the bulk of the new season's crop will be dealt with in that way.

SOUTH AFRICAN CHROME.—Completion of the new plant in South Africa, of Marble, Lime, and Associated Industries, Ltd., for the manufacture of chrome chemicals is revealed in the company's annual report. As the capacity of the new plant exceeds domestic requirements, an export trade has been launched.

Canada and Civil Aviation

THE Canadian Minister of Munitions and Supply, Mr. C. D. Howe, spoke in London on Monday, October 18th, about the recent conference with other representatives of the Dominions and India on civil air transport. He said that in the talks on the relation of civil flying to world peace and the general integration of the efforts of the Empire, a common view on general principles had been arrived at. Proposals for a conference between the nations interested in civil aviation after the war would shortly be made, and it was possible that such a meeting would be held before the end of the war. Mr. Howe also dealt with the internal system of civil aviation which had been built up in Canada, and said that he felt that the Dominion was well able to make a strong contribution to post-war Empire air transport. Stretching from Newfoundland in the east to Victoria in the west, Trans-Canada Airlines had approximately 5000 miles of air routes which were covered at least twice daily. The Canadian Pacific Airline had a system covering approximately 3000 miles of air routes. These two lines were flying about 13 million miles a year, and constituted a civil aviation network which made it desirable that Canada should participate in flying to countries overseas. Canada had, Mr. Howe continued, a well-developed line of aerodromes from Alaska to the American boundary, and before the war there had been a chain of airports from the Atlantic to the Pacific.

Sixty Years Ago

UNITED STATES WARSHIPS

SIXTY years ago the United States had practically no Navy. In addition, it had no facilities for building modern warships. It was true that it had no mercantile marine to protect, but its lack of sea power placed its seaports at the mercy of any third-rate Navy bent on making trouble. The policy which left the country entirely unable to defend its enormous wealth was about to be changed. After much fuss and turmoil, the Naval Advisory Board had produced designs for three types of warships, and orders for their construction had been placed. The first type was a twin-screw cruiser, the second a single-screw cruiser, and the third a dispatch boat. In our issues of October 26th, November 2nd, and November 9th, 1883, we published drawings and descriptions of these vessels, our information being derived from a paper by Mr. F. T. Bowles, the secretary of the Naval Advisory Board. In a leading article in the first-named issue we criticised the designs, particularly that of the twin-screw cruiser. The ship was to carry four 8in., eight 6in., and two 5in. guns, of which the 8in. guns were to be mounted in open sponsons on the upper deck in such a manner as to place the gun crews completely at the mercy of an enemy ship equipped with Hotchkiss or Nordenfelt machine guns. The twin screws were to be driven by compound beam engines, the argument in their favour being that they had long been successfully employed in paddle steamers. Each of the fourteen boilers was to consist of a cylindrical return-tube shell resembling a Scotch boiler, with the furnace omitted. The shell was to rest on a brick-lined casing providing a single external furnace extending almost full width beneath the boiler. We saw in the hull the machinery and the boilers of the ship "a manifestation of that desire to be original at any cost, which has done so much harm already to the United States Navy." The genius of the country did not seem to lie in warship design. At every turn the English engineer and naval architect would find something defective in the new type of twin-screw cruiser. No such engines and no such boilers were to be found in a British warship. The Naval Advisory Board could rest assured that there were good reasons for that fact. It would regret not having availed itself of our experience.

Markets, Notes and News

The prices quoted herein relate to bulk quantities. Unless otherwise specified home trade quotations are delivered f.o.t. Export quotations are f.o.b. steamer

China's Post-War Reconstruction

Great opportunities should be open for British engineers and engineering products in China in the period of reconstruction which will follow the war, according to a statement issued by the Chinese Consulate-General. As soon as peace is restored, it is stated, China will look forward to a period of modernisation and industrialisation. There are tremendous potentialities for development in that country's transport and communication services. Plans have been made for China's rehabilitation and reconstruction. A plan has been formulated for a national transport system in which railways, highways, waterways, and airways have been mapped out and co-ordinated and a national communication system in which telegraph, radio, city and long-distance telephones, broadcasting, and a post office are all interrelated. Both national economy and national defence have been taken into consideration without sacrifices to international needs. Several committees have been formed to work on the standardisation and the specifications of equipment and materials required by railways, ships, aeroplanes, telegraphs, and telephones. This work has been going on for several years and will be pushed to completion in the near future. The need for international co-operation has not been forgotten nor the necessity of diverting surplus productive energy and man power now engaged in war industries to developing China's vast resources. Foreign capital in the form of machinery and materials will be greatly needed, provided the investment is consistent with the principle of equality. Foreign technical assistance will be needed also. During the war Chinese engineers have built railways, highways, bridges, tunnels, aerodromes, &c., with commendable speed; but, in view of the magnitude of post-war reconstruction, China will require many more engineers and experts. China is self-sufficient in many kinds of raw materials, but it is suggested that after the war first attention should be given to the development of iron and steel, metallurgical, mechanical, and basic chemical industries; then to communication and electrical industries and to industries such as textiles, cement, soap, leather, and food production; finally to defence and other industries. The development of mineral resources, according to the order of importance, should include copper, aluminium, zinc, iron, manganese, and then export minerals, such as tungsten, antimony, tin, and mercury. China is not self-sufficient in rubber, iron, nickel, chromium, vanadium, copper, lead, and zinc. Amongst these materials the most serious shortage is that of iron, the deposits in China being less than 1 per cent. of the world's deposits.

The Pig Iron Market

Although the pig iron position in Great Britain has become easier, that does not mean that it is entirely free from stringency. The increased production of medium and low-phosphoric pig iron and, to a lesser degree, of hematite has resulted in more liberal supplies becoming available, but the production still falls short of consumers' requirements, which have been for a long time on a heavy scale. The hematite position is the most difficult, but it is anticipated that the imports of high-grade ore from North Africa will increase and enable production to be considerably expanded. At present the Control still finds it necessary carefully to supervise the distribution of hematite and low-phosphoric pig iron. Hematite is only released for special work and when no other description of pig iron is suitable. As a result there is still a heavy demand for pig iron which can be used as a substitute. Apart from hematite, however, the producers of pig iron seem to have no great difficulty in meeting the allocation made to consumers by the Control. Engineering and allied foundries are the principal users of hematite. These are engaged upon castings required in connection with Government contracts for tanks, armaments, and machine tools and for the most part their requirements come within the priority categories. Engineering foundries, however, are using considerable quantities of high-phosphoric pig iron and as this pig iron is in liberal supply the foundries are in a comfortable position. The light foundry industry is in much the same position that it has been during the whole of the year. Until these foundries are able to cater for their normal customers, which are principally concerned with the building trades, it is not likely this branch of the industry will be well employed. Generally speaking, the foundry trade has not been busy for some weeks. There is still a reasonable demand for refined pig iron, but lately new business has been rather slack. In the case of ordinary foundry pig iron consumers are showing a disposition to limit their purchases to near delivery dates.

Scotland and the North

Production by the Scottish iron and steel works during September was particularly high, calculated on an ingot basis, but there has been some change in the incidence of the demand owing to alterations in the war production programme. In some cases the call for materials for the manufacture of certain armaments has declined, but this has been balanced by a heavier call in other directions. The production of plates is fully maintained and the output of the mills is earmarked for a considerable time. The structural steel position has not changed lately and, if anything, the demand for the lighter sizes of sections is increasing, whilst the call for the heavier sorts is only moderate. The marine engineers in Scotland are working to capacity and their requirements of steel, including plates, are particularly heavy. The engineering works generally are consuming large tonnages of steel bars and delivery dates, for some of the heavier sizes show a tendency to become more prolonged. All the sheet mills are well employed and for the most part are sure of being fully occupied until early in 1944. They are turning out good quantities of light plates, which has relieved the pressure on the plate mills to a certain extent. There is a good demand for alloy steel, although the pressure in this department has declined considerably since the earlier part of the year. Works making bright-drawn steel are assured of busy conditions for some time to come. Special steels are in strong request by engineers engaged upon production of armaments and munitions. Supplies of colliery steel, including roofing bars, arches, props, &c., are directed by the Ministry of Fuel and Power, and although there is a steady demand the works are maintaining regular deliveries. The Lancashire iron and steel position has not changed for some weeks. Some engineering works, employed largely upon special work, have experienced a lull in demand, but this has not been general. There is still an active demand for special steel and for bright-drawn steel bars. The steel trade in the Lancashire district has sufficient work in hand to keep it employed at full stretch for some months, but the producers are maintaining a steady rate of delivery. The steel works on the North-West Coast are employed to capacity and big deliveries have been maintained.

The North-East Coast and Yorkshire

The iron and steel situation on the North-East Coast has not materially altered, but if there is any change, it is in the direction of a relaxation in the pressure for certain products which are not required with the same urgency as of late for the war production programme. A general survey of the industry, however, would not disclose any noticeable decline in output, and there is enough work on the books of the steel works to keep the whole industry in this district operating at capacity to the end of the year. The orders on the books for delivery in the fourth quarter reached a heavy tonnage and there seems no likelihood of any decline in activity for many months to come. The raw materials situation is comfortable and, in the case of some materials, such as coke, the supply has overtaken the demand. The re-rolling industry is well situated as regards the supply of raw materials. Ample supplies of billets have been available since the increased production of English and Welsh works earlier in the year. When a stringency in the supply of billets threatened several weeks ago the Iron and Steel Control arranged for weekly allocations to be made from certain works to some of the re-rolling plants, and this had the effect of considerably easing the situation and giving confidence to consumers. The use of defectives, crops, and other material, which for a long time have been used by the re-rollers to supplement the supply of prime material, is not on such an extensive scale, but is still necessary for the majority of the re-rollers. The plate position does not alter, and it is unlikely that there will be any relaxation of the insistent demand while the war lasts. The quantities of plates taken by the shipbuilders show no diminution, and recently there has been an expansion in the request for boiler plates. Big tonnages of plates have passed to the heavy engineering industry recently, whilst there has been a steady call from locomotive builders and wagon builders. The Yorkshire steel industry is fully extended on the production of material required for war purposes. The demand for basic steel has been fully maintained and there are no indications of a decline in the volume of business in this description. The makers of acid carbon steel are operating at capacity and the plant available is fully taxed to meet consumers' requirements. The alloy steel position is comfortable and there does not seem to be any stringency in this department; in fact, it is stated that the production of alloy steel has been expanded to a degree which has reversed the situation which existed in this department a few months ago.

The Midlands and South Wales

The Midland iron and steel works are operating at a high rate and practically the whole production passes into early consumption for war purposes. The improvement which has taken place in the semi-finished steel position has enabled the re-rollers to meet the heavy demand which they have experienced for some months. Billets reach them from English and Welsh works; but although there is a considerable consumption of prime billets, the re-rollers have to use quantities of defectives and crops, and these, together, provided them with all the semi-finished materials required. In some cases works have experienced a difficulty in getting all the flat billets they need, as the production is less in proportion to the production of other descriptions. The re-rollers are heavily engaged upon the manufacture of small bars and sections, and there seems little likelihood of this class of business declining for a long time. The steel works are equally pressed to meet consumers' full requirements, but the distribution scheme has worked well and has enabled the makers to maintain supplies to the consuming industries. The abnormal demand for plates shows no sign of shrinking, and although the larger proportion of the output goes to the shipyards, there has lately been an increased demand for boiler plates. There is an insistent demand for the lighter sizes of structural steel, and these are being turned out in big quantities by the re-rollers and steel works. Big tonnages of shipbuilding sections are required, but the works maintain a steady rate of delivery. There is only a moderate demand for heavy joists and sections and buyers find little difficulty in placing orders for comparatively near delivery; this, however, has been a feature of the market for a long time. The majority of the steel works in South Wales are booked to capacity to the end of the year and it is not easy to place orders for delivery before that date unless they are of the most urgent priority character. Large tonnages of heavy steel plates and light sections for shipbuilding are being produced and are passing almost immediately into consumption. On the other hand, consumers' requirements of heavy joists and sections are not large, and the works producing this material can execute orders without undue difficulty. The Welsh works producing billets and sheet bars are operating at capacity, whilst there are ample supplies of sheet and tinplate bars to meet consumers' requirements. The sheet mills in South Wales are fully employed.

Iron and Steel Scrap

In recent weeks there has been a noticeable tendency for the demand for most descriptions of iron and steel scrap to expand, but the movement is slow and the demand is principally for the heavier and better descriptions. The increased volume of business in the lighter sorts is chiefly due to more of this quality being used to fill up the gaps in supply, due to the tightness of certain of the heavier grades. Most consumers would welcome larger supplies of heavy mild steel scrap cut to furnace and foundry sizes. There is also a strong request for hydraulically compressed steel shearings from the acid steel makers, who seem prepared to take up considerable quantities. Large tonnages of mild steel turnings are arising, and after a quiet spell of trading greater activity has developed, as users are taking larger quantities of good heavy and chipped grades. The basic steel furnaces are willingly taking any parcels of mixed wrought iron and steel scrap which become available. Good heavy material has been in somewhat short supply and, in fact, is less freely offered than recently. There is only a quiet demand for the light material, although the volume of business in this description has improved. There is also a better demand for compressed basic bundles, and this movement can be attributed to the shortage of heavy material. Cast iron scrap generally is in rather stringent supply. In this section of the market consumers are interested chiefly in good heavy material. Good cast iron machinery scrap in cupola sizes finds ready buyers, but many consumers have not yet covered their allocations. Although there are indications of an improvement in the demand for alloy steel scrap, only moderate quantities of it appear to have changed hands. Mixed alloy turnings in particular have had a slow market for some time, but recently suitable parcels have been taken up more readily. A fairly active business also is passing in carbon turnings.

Notes and Memoranda

Air and Water

ALL-WOOD COAL-FIRED TUG.—There was recently launched from a yard in Los Angeles, Calif., the first coal-burning, steam-driven, wooden, seagoing tug of this war. Christened "Power," this U.S. Maritime Commission tug is 157ft. in length, has a 32½ft. beam, contains about 400,000 board feet of lumber, and is the largest all-wood tug yet constructed on the Pacific Coast. The vessel was 161 days on the ways, but it is expected that the remaining fifteen tugs ordered will be launched in one-third of that time, as the delays incident to new construction have been eliminated.

A TORONTO SHIPYARD TRANSFERRED.—The management and operation of the shipyard of the Toronto Shipbuilding Company, Ltd., has been taken over by the Redfern Construction Company, of Toronto. According to a spokesman for the Naval Shipbuilding Division of the Munitions Department, this step was "just a matter of improving production" in those yards. He declined to comment further. The Toronto Shipbuilding Company was itself taken over by the Dominion Government from private interests for 975,000 dollars in 1941.

PORTABLE PIPE LINES.—An American engineering journal has disclosed the fact that a portable pipe line originally assembled for a lend-lease line along the Burma Road was diverted to other theatres of operation when that road was taken by the enemy. Four such lines for petrol and water have been in use in the African campaign in lengths of 75 to 300 miles, and one, now in Sicily, may be moved to Italy. The water line is composed of a 4in. diameter spiral welded pipe weighing only 90 lb. for a 20ft. length and connected by simple couplings that can be attached quickly. The pipe can be laid at the rate of 10 to 30 miles per day by unskilled labour or Army personnel. The petrol supply is on similar lines.

AN AERIAL FERRY.—Acting on the advice of U.S.A. Army engineers, the Bolivian authorities have had erected a cable bridge across the River Espiritu Santo, on the route between the cities of Cochabamba, in the highlands, and Podos Santos. A road crossing the river can be forded in the dry season, but is impassable during the rains. A highway bridge, 1185ft. long and high enough to withstand these floods, would have been costly. The so-called aerial ferry, built by one of the leading American builders of suspension bridges, consists of a light, 100ft. steel tower on each side of the river, two steel cables, 1185ft. long, and a tramcar or enclosed cage suspended from a carriage on a two-cable track.

A CANADIAN WATER-DIVERSION SCHEME REVIVED.—The Canadian Dominion Government has organised a survey party for work in the Rocky Mountain House area of Alberta, going over a survey made nearly forty years ago by William Pearce, a civil engineer, who then drew up plans for a scheme to divert water from the North Saskatchewan River into dry creeks, sloughs, and lakes in the area between the north and south branches of the river. The Pearce survey did not contemplate an irrigation scheme, but a water diversion for the advantage of farms and livestock, to use water now flowing to Hudson Bay. Pearce's idea was to build three big dams at Windy Point, 100 miles west on the North Saskatchewan River; at Phœnix, 30 miles west; and at a point 18 miles west of Rocky. Water would be turned, it was proposed, from the North Saskatchewan into the Clearwater River, that river's course turned so that it would flow into the Red Deer River, and so on out to the plains towards the east.

Miscellanea

ADMISSION OF NON-MEMBERS TO I.E.E. MEETINGS.—The Council of the Institution of Electrical Engineers has had under consideration for some time the question of making the technical meetings of the Institution accessible to those who may be interested in the proceedings, but who may consider that their technical experience and educational attainments do not suffice to admit them to any form of Institution membership. With this end in view, the Council has ordered that a person in this category who is interested in the proceedings at ordinary meetings, section meetings, local centre meetings, and informal meetings shall be provided by the Secretary with an application form, on the completion of which and on payment of a fee of 7s. 6d. to cover administration costs, he may receive notices of meetings and an invitation card which will serve as a title of admission to the technical meetings of the Institution during the forthcoming session in London and in the provinces. The possession of the invitation card will not confer upon the holder any status within the framework of the Institution, nor will he have the right to join in the discussions without special permission from the chair.

NEW D.S.I.R. APPOINTMENTS.—It is announced by the Department of Scientific and Industrial Research that the Lord President of the Council has appointed Mr. J. Benstead and Mr. E. Thornton to be members of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research from October 1st, 1943. Sir John Greenly retired from the Council on completion of his term of office on September 30th, 1943. Mr. Benstead is the General Secretary of the National Union of Railwaymen. Mr. Thornton is the Secretary of the United Textile Factory Workers' Association and Secretary of the Rochdale Weavers' Association.

N.W. LONDON SUPERVISORS' DISCUSSION GROUP.—A meeting of the N.W. London Supervisors' Discussion Group was held at Acton Technical College on October 6th, over 200 members being present. Mr. W. Puckey, general works manager, Hoover, Ltd., Perivale, delivered an address entitled "The Foreman as a Manager," which was followed by a discussion. Mr. G. Still, A.E.C., Ltd., Southall, took the chair and was assisted by Mr. Knapp, Chairman of the Group, and Mr. J. D. Shackman, of the Institute of Industrial Administration. The next Group meeting will be held at Acton Technical College, High Street, Acton, on Wednesday, November 3rd, at 7 p.m., when Mr. S. F. Blanch, director and general manager of the British Light Steel Pressings and manager of Acton works of the Sunbeam-Talbot Motors, Ltd., will deliver an address entitled "What are the Values to Industry of Joint Production Consultative and Advisory Committees?" All foremen and supervisors who are interested are invited to attend.

THE INSTITUTE OF FUEL.—There was a large and influential gathering at the Connaught Rooms on Thursday, October 14th, when a luncheon took place before the Presidential Address and the delivery of the Melchett Lecture. The Past-President, Mr. W. M. Selvey, presided, and in a few well-chosen words, in which he referred to his happy term of office, he introduced the new President, Dr. E. W. Smith, who took the chair. Dr. Smith expressed the hope that Mr. Selvey would continue to give his valuable aid to the Institute by taking an active part in the committee work. Replying to the toast of "The Guests," proposed from the chair, Major Lloyd George, the Minister of Fuel and Power, paid a warm tribute to the help which his Ministry had received from the Institute, particularly from Dr. Smith and the Melchett Lecturer (Dr. E. S. Grumell). In return, he pledged his and his Ministry's fullest help for the important work the Institute was carrying out in connection with the conservation and scientific development of our national fuel supplies. At the afternoon meeting, the Student Medal was presented to Mr. F. P. Maggs for his paper on "The Relation Between Heat of Working and the Absolute Value of the Surface Area of Coals," and the Melchett Medal was presented to Dr. E. S. Grumell. In his Presidential Address, Dr. Smith dealt with fuel policy and the work of the Institute, and looked forward to a future time when the coal, gas, and electrical industries would reverse completely their past policies, and whilst supplying the consumer with all his requirements for heat, light, and power in the most necessary and liberal way, would, at the same time, guarantee the nation that such supplies should be used in the most efficient way. Dr. Grumell took as the subject of his lecture the "Conservation of Resources."

Personal and Business

MR. H. BOOT has been appointed assistant general manager of the Consett Iron Company, Ltd.

MR. R. E. STEINBERG, M. Inst. C.E., has been appointed chairman of Considere Constructions, Ltd., in succession to the late Mr. T. C. J. Burgess.

MR. ARNOLD HECKLE has been appointed Regional Controller of Factory and Storage Premises for the Midland Region, in succession to Mr. A. D. Carmichael.

THE CENTRAL ELECTRICITY BOARD has appointed Mr. E. J. Edgar to be district manager for the Central and South Scotland areas. He succeeds Mr. A. E. MacColl, who is taking up new duties as deputy chairman and chief executive officer of the North of Scotland Hydro-Electric Board.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

Association for Scientific Photography

Saturday, Oct. 23rd.—Inst. of Mechanical Engineers, Storey's Gate, Westminster, S.W.1. "Mechanical Engineering: the Use of Photographically Sensitised Metal, Wood, and Plastics," A. H. Tiltman and and S. A. Woodward. 2.30 p.m.

Association of Austrian Engineers, Chemists, and Scientific Workers in Great Britain

Monday, Oct. 25th.—69, Eton Avenue, Swiss Cottage, N.W.3. "The Tennessee Valley Authority," D. C. Coyle. 7 p.m.

Thursday, Oct. 28th.—Inst. of Mechanical Engineers, Storey's Gate, Westminster, S.W.1. "District Heating," P. Kaufman. 7 p.m.

Association of Building Technicians

To-day, Oct. 22nd.—Westminster Hospital Medical School, Westminster, S.W.1. "County of London Plan," A. Ling. 6.30 p.m.

British Association of Refrigeration

Thursday, Oct. 28th.—Inst. of Mechanical Engineers, Storey's Gate, Westminster, S.W.1. "Air Conditioning: Wartime Applications and their Peacetime Significance," B. C. Oldham and G. E. Clifford. 5.30 p.m.

Fuel Luncheon Club

Thursday, Oct. 28th.—Connaught Rooms, Great Queen Street, Kingsway, W.C.2. Presidential Address, by J. Charrington. 12.40 for 1.10 p.m.

Institute of British Foundrymen

Saturday, Oct. 23rd.—Loughborough College, Loughborough. "Radiography as an Aid to Foundry Technique," W. Gladwell. 3 p.m.

Institution of Civil Engineers

Saturday, Oct. 23rd.—N.W. Assoc.: Engineers' Club, Albert Square, Manchester. Chairman's Address, by T. Elce.

Institution of Electrical Engineers

To-day, Oct. 22nd.—MEASUREMENTS SECTION: Savoy Place, Victoria Embankment, W.C.2. Chairman's Address, by E. W. Moss. 5.30 p.m.

Institution of Engineers-in-Charge

Saturday, Oct. 23rd.—St. Bride Institute, Bride Lane, Fleet Street, E.C.4. "Educational Reconstruction," J. Gayfer. 2.30 p.m.

Institution of Locomotive Engineers

Wednesday, Oct. 27th.—Inst. of Mechanical Engineers, Storey's Gate, Westminster, S.W.1. "Locomotive Power," E. C. Poultney. 5.30 p.m.

Institution of Mechanical Engineers

To-day, Oct. 22nd.—Storey's Gate, Westminster, S.W.1. Presidential Address, "Remember the Past and Look to the Future," Professor F. C. Lea. 5.30 p.m.

Saturday, Oct. 23rd.—SOUTHERN BRANCH: Kimbell's Restaurant, Osborne Road, Southsea. "Naval Machinery: Some Factors Influencing its Design," Eng. Vice-Admiral Sir George Preece. 2 p.m.

Institution of Production Engineers

Friday, Oct. 29th.—Grosvenor House, Park Lane, W.1. Annual general meeting. "Human Element in Production," Sir Stafford Cripps. 3 p.m.

Institution of Sanitary Engineers

To-day, Oct. 22nd.—Caxton Hall, Westminster, S.W.1. "The Corrosion of Mains in Clay Soils," H. J. Bunker. 5.30 p.m.

Institution of Structural Engineers

Wednesday, Oct. 27th.—College of Technology, Manchester. Film on "The Failure of the Tacoma Narrows Suspension Bridge." 6.30 p.m.

Iron and Steel Institute

Saturday, Oct. 30th.—Technical College, Newport. "The Yield Point in Steel," C. A. Edwards, D. L. Phillips, and Y. H. Liu. 6 p.m.

Junior Institution of Engineers

To-day, Oct. 22nd.—39, Victoria Street, Westminster, S.W.1. "Mechanisation of Mines," J. K. Davies. 6.30 p.m.

Friday, Oct. 29th.—39, Victoria Street, S.W.1. Films on "Transport of Power" and "And Now They Rest." 6.30 p.m.

North-East Coast Institution of Engineers and Shipbuilders

Friday, Oct. 29th.—Mining Institute, Newcastle-upon-Tyne. "Experimental Fluid Dynamics Applied to Engineering Practice," Dr. G. A. Hankins. 6 p.m.

"Practical Planning" Exhibition

To-day, Oct. 22nd to Saturday, Oct. 30th.—Institution of Civil Engineers, Great George Street, S.W.1. 10 a.m. to 6 p.m. (except Sundays). Conference: Wednesday, October 27th, "Alternative Materials and Methods of Construction in Buildings." 2.30 p.m.

Women's Engineering Society

To-day, Oct. 22nd, to Monday, Oct. 25th.—Annual conference at Manchester.